Neal Jensen

# 1965

# OAT NEWSLETTER

Vol. 16



April 1, 1966

Sponsored by the National Oat Conference

1965

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Vol. 16

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May 15, 1966

Sponsored by the National Oat Conference

Neal F. Jensen, Editor

## ANNOUNCEMENTS

Overseas contributions - Foreign contributors are urged to anticipate the annual call for material for the next Newsletter and to submit articles or notes to the editor at any time of the year.

Available back issues - Back issues of the 1956, 1960, 1961, 1962, 1963, and 1964 Newsletters are available on request.

Variety descriptions - It would be helpful if you name or announce a new variety if, in addition to your account in the State report text, you would submit a separate description which could be included under the "New Varieties" section. This section, apparently, is one that is repeatedly referred to and we would like to make it as useful as possible.

## PLEASE DO NOT CITE THE OAT NEWSLETTER IN PUBLISHED BIBLIOGRAPHIES

Citation of articles or reports of Newletter items apparently is causing some concern. The policy of the Newsletter, as laid down by the oat workers themselves and later reiterated, is that this letter is to serve as an informal means of communication and exchange of views and materials between those engaged in oat improvement. Just as definitely, no material is wanted which is of a nature that it fits a normal journal pattern and each year's call for material emphasizes this point. Unless there has been a change of thinking the oat workers do not aspire to a newsletter that would in any way discourage informality, the expression of opinions, preliminary reports, and so forth.

Citing the Newsletter creates a demand for it outside the oat workers' group. For example, libraries send several requests a year for it and we refuse them (if the Newsletter were made available to libraries it could not be produced as we now do it because the mailing list would approximately triple in number). So why cite it in a bibliography?

Certain agencies require approval of material before it is published. Their approval of material which goes into the Newsletter is a different evaluation from approval for publishing. A recent letter thinks that abuse of this informal relationship by secondary citation could well choke off the submission of information.

One suggestion which may help: if there is material in the Newsletter which is needed for an article, contact the author. If he is willing, cite him rather than the Newsletter. This can be handled by the phrase "personal communication". (Ed.--repeated from 1964).

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## I. CONFERENCE AND REGIONAL NOTES

The quadrennial meeting of The Oat Conference was held February 9-11, 1966 at Michigan State University, East Lansing, Michigan with Dr. John Grafius and his colleagues doing a fine job of hosting. Through the fine cooperation of all involved we are able to present in The Newsletter, abstracts of nearly every paper given.

Drs. R. L. Thurman and J. P. Jones announced that The Southern Small Grain Technical Workers Group will meet April 27-28, 1966 at the University of Arkansas, Fayetteville.

### ORGANIZATION OF NATIONAL OAT CONFERENCE

#### Executive Committee

Chairman - H. C. Murphy
*Past Chairman - J. E. Grafius
*Secretary - F. L. Patterson
*Editor Newsletter - N. F. Jensen

Representatives:

North Central Region - H. L. Shands, J. M. Poehlman, Dale A. Ray
North Eastern Region - G. C. Kent, H. W. Crittenden
Southern Region - U. R. Gore, D. T. Sechler
Western Region - C. F. Konzak, F. C. Petr
Cereal Crops Research Branch - L. A. Tatum
Oat Investigations - H. C. Murphy

*Non-voting

### Minutes of National Oat Conference
### Kellog Center, Michigan State University
### East Lansing, Michigan
### February 9, 10, and 11, 1966

A complete program for the Conference and abstracts of all the formal presentations are presented elsewhere in this Newsletter. Consequently, summaries of the formal presentations will not be included in the minutes.

Wednesday Morning, February 9 --- J. E. Grafius, Presiding ---

The first session of the Conference was called to order at 8:30 a.m., February 9, by the Conference Chairman, J. E. Grafius.

About 85 were in attendance from 22 States, 4 Canadian Provinces, and 4 countries. This was slightly more than attended the Conference at Gainesville, Florida, in 1962 and about as many as were present at LaFayette, Indiana, in 1958. In addition to oat workers from State experiment stations, the U.S. Department of Agriculture, and government agencies in Canada, Colombia and Wales, representatives were also present from the Crop Quality Council, Coker's Pedigreed Seed Company, McNair Seed Company, McCurdy Seed Company and the Quaker Oats Company.

Chairman Grafius first announced the election of H. C. Murphy as Chairman of the National Oat Conference by the Executive Committee. His term of office to begin at the conclusion of the Conference and to extend until the conclusion of the next Conference. The Chairman also announced the appointment of F. L. Patterson as Secretary for the same term of office.

The Acting Secretary, H. C. Murphy, was called on for the minutes of the last Conference (January 23-25, 1962, Gainesville, Fla.). He indicated that the minutes had been prepared by Secretary F. A. Coffman (retired) and that they appear in detail on pages 9-22 of the 1961 Oat Newsletter (issued March 1, 1962). A summary of the minutes were presented. No comments, revisions, or corrections were made. The minutes were accepted as previously published.

The Chairman next called on Neal F. Jensen, Editor of the Oat Newsletter, for a report. He had no formal report to present but requested the Conference select a replacement for him as Editor of the Newsletter. Dr. Jensen has been Editor of the Newsletter since the 1950 National Oat Newsletter, Volume 1, was issued February 1, 1951. He indicated that immediate action was not necessary, but he would appreciate the Conference arranging for a replacement within the next year or two.

M. D. Simons, Chairman, presented the report of the Genetic Nomenclature Committee. The present Committee (N. F. Jensen, M. D. Simons, and F. J. Zillinsky) and past Committees have developed a systematic method of designating genes in oats. A total of 193 genes controlling 33 oat characters, have been catalogued. A listing and description of the 193 genes designated to date are about ready for publication. A report of the previous genetic Nomenclature Committees is presented in the Oat Newsletter, Volume X, pp. 2-8.

F. L. Patterson asked about genes controlling pathogenicity of oat pathogens. Simons replied that not enough is known at this time about genes for pathogenicity to assign symbols.

Dr. Sylvan H. Wittwer, Director, Agricultural Experiment Station, Michigan State University, welcomed the National Oat Conference to Michigan. Director Wittwer mentioned that 10 percent of his time was devoted to research in the Department of Horticulture and that he not only had a primary interest in agricultural research but was still actively engaged in research. He informed the group about new 2 million dollar structures being erected on the MSU campus for atomic energy and pesticide research. Dr. Wittwer emphasized the value of oats for grain and forage and noted that MSU had three men (J. E. Grafius, A. H. Ellingboe, and R. P. Sheffer) engaged in oat research. Dr. Wittwer mentioned the wide use of the Avena coleoptile in basic research in plant physiology and used crown rust as an example of a pathogen that might be utilized in a study of the biochemical basis for disease resistance. He pointed out that most grains are long day crops and referred to the classic studies of J. E. Grafius on the adaptation of varieties to a specific environment, especially night temperature. The use of CCC (2-chloroethyl trimethylammonium chloride) to prevent lodging and increase the yield of small grains and the use of increased levels of $CO_2$ to double and triple the yield of horticultural crops in the greenhouse were used as illustrations of the significance and importance of new approaches in agricultural research. He emphasized the physiological potential and importance of leaf tissue in photosynthesis and used the pineapple as an example of a crop with low moisture requirement resulting primarily from stomatal opening and carbon fixation at night.

Dr. Wittwer outlined the progress achieved to date by workers at MSU and Purdue University in controlling the cereal leaf beetle. He mentioned the encouraging resistance to the beetle being found in wheat and its apparent relation to some kind of pubescens. The advantage of low volume application of malathion for controlling the cereal leaf beetle and for applying fertilizers, hormones, etc. was reviewed. He also emphasized the possibility of improving the feed and food value of oats by obtaining an increase in total protein and a better balance of the more essential amino acids.

H. C. Murphy, H. G. Marshall, P. G. Rothman, and F. C. Petr next discussed the uniform USDA oat nurseries. The organization of these nurseries as outlined by Murphy were as follows:

H. C. Murphy, Coordinator --

International Oat Rust Nursery (with W. Q. Loegering)
Uniform Oat Rust Nursery
Uniform Soil-borne Oat Mosaic Nursery
Uniform Spring-Sown Oat Smut Nursery
Uniform Midseason Oat Performance Nursery
Uniform Early Oat Performance Nursery
Uniform Wild Hexaploid Oat Rust Nursery

H. G. Marshall, Coordinator --

Uniform Northern Winter Oat Nursery
Uniform Winter Hardiness Oat Nursery
Uniform Elite Hardy Winter Oat Nursery
Uniform Hardy x Hardy Winter Oat Nursery

P. G. Rothman, Coordinator --

Uniform Central Winter Oat Nursery
Uniform Southern Winter Oat Nursery

F. C. Petr, Coordinator --

Uniform Northwestern Oat Nursery

F. C. Petr reported that oat yields were exceptionally good in 1965 in the Western Region with ample water for irrigation and higher moisture than usual on the dry land. Orbit and a Craig x Alamo selection, from N. F. Jensen's program, were outstanding for yield in the 1965 Northwestern Nurseries. Russell and the new Bingham variety were also high in overall performance with AuSable from Michigan being outstanding for test weight.

P. G. Rothman reported a dismal year for the Southern Winter Oat Nurseries with drought, low temperatures, and crown rust being limiting factors. The new Florida 500 was outstanding for resistance to crown rust, whereas Ora from Arkansas and some of the new Coker selections were outstanding for yield.

H. G. Marshall said his greatest problem with the Northern Winter Oat Nurseries was to get them through the winter. Although there has been striking improvement in winter hardiness in oats, the recent severe winters illustrate the need for even greater hardiness.

Chairman Grafius announced the assignment of rooms for the evening meeting of the Northeastern oat workers (Room 101, 7:30 p.m.) and North Central oat workers (Room 107, 8:00 p.m.) before declaring a mid-morning recess.

The Conference reconvened promptly at 10:15 a.m. Because of unfavorable weather, R. C. Frohberg was delayed in arriving. Consequently, H. L. Shands kindly exchanged his presentation that had been scheduled for 9:30 a.m. on February 11. Otherwise, the presentations were delivered as scheduled.

Some of the key questions asked the above speakers, and their answers were:

To Ray: How were the culms bent in the lodging study? Answer: Manually, using the fingers.

To Burrows: Is yield related to lodging? Answer: It is difficult to combine lodging resistance and yield. More culms per unit area may be the answer to yield.

To Browning: Are new recurrent parents being added for the development of future multiline varieties? Answer: We are continuing to modify the two recurrent parents by adding better genes for resistance to stem rust, BYDV, etc.

To Jensen: What responsibility will your foundation seed organization assume if seed does not meet certification requirements in other States? Answer: We have every intention of producing high quality seed.

<u>Wednesday Afternoon, February 9 --- A. H. Ellingboe, Presiding</u> ---

The Wednesday afternoon session started promptly at 1:30 p.m., with all presentations for the afternoon being delivered as scheduled except those by H. H. Luke and B. J. Roberts. Neither H. H. Luke nor D. T. Sechler was able to attend the Conference. Their presentation was not delivered, but an abstract was received. B. J. Roberts could not attend because of illness. His paper was presented by M. B. Moore. (See abstracts)

Following the formal presentations, N. F. Jensen called attention to the availability and value of early generation composites of oat hybrids being maintained by the USDA and requested the cooperation of all oat breeders in adding to these stocks.

M. B. Moore commenting on Brian Clifford's presentation stated that adult plant resistance or a moderate type of resistance may be all the rust resistance that is needed under field conditions. (C.I. 3034 which has been tested with all races of stem rust as reported by McKenzie and Green would be an example).

<u>Wednesday Evening, February 9</u> ---

Minutes of the Meetings of the NC-15 and NE-23 Technical Committees were recorded by their respective secretaries and will not be reported here.

<u>Thursday Morning, February 10 --- H. L. Shands, Presiding</u> ---

The Thursday morning session was convened at 8:35 a.m. All presentations were delivered in the order shown on the program. Unfortunately, not enough time was allotted for this group of excellent presentations, and most speakers exceed their time allotment. Consequently, there was no time left for discussion of the early morning presentations and very little time for the later ones. (See Abstracts)

Some of the key comments and answers to questions were as follows:

Grafius suggested that the most economical utilization of heterosis in oats may be in the $F_2$ generation.

To Western: Is fatty acid the same as total fat? Answer: I think so.

To Western: Is the low viability of hull-less oats due to high fatty acids? Answer: It may be.

Shands to Klinck: Is dehulling a characteristic of thin hulled oats? Answer: Yes.

Western commented that it should be possible to develop a high test-weight oat with a long thin hull and a plump groat with adequate lemma and palea length. He mentioned the Clinton-Clintland types as being some of the best not available from the standpoint of overall high test weight, low hull percentage, plump groats, adequate lemma and palea length, and milling yield.

Thursday Afternoon, February 10 --- D. E. Western, Presiding ---

Except for W. R. Graham, the presentations listed in the program were delivered as scheduled. Dr. Graham was unable to attend because of illness, and no abstract of his paper was received. (See Abstracts)

Some key comments and answers to questions were as follows:

K. J. Frey reported a 15-bushel per acre increase in yield from precision planting and wondered whether we should not go to 6-inch rows for nursery yield testing.

J. E. Grafius reported a significant increase in yield from banding application of fertilizer.

Frey mentioned that addition of fertilizer also advanced maturity which had an added "disease escaping" value.

H. L. Shands commented that alfalfa and other legume seedings must be kept in mind when adding fertilizer to oats. High fertilizer applications have given poor stands of legumes in Wisconsin.

Frey was of the opinion that newer varieties can utilizer 60-80 lbs. of nitrogen, yield 140-160 bushels per acre, and still support a good stand of legumes.

C. M. Brown thought we should try for high yields and forget about the effect on stand of underseeding.

R. M. Caldwell, H. Jedlinski, Frey, Western, and others commented on the unexpected high yields from delayed seeding and especially on the higher yields of later maturing varieties in recent years. Frey said the last 8 years have been favorable for late varieties in Iowa.

C. F. Murphy suggested the establishment of a uniform stiff-strawed nursery which would be grown under low and high fertility and protected from foliar diseases.

C. M. Brown noted that Andrew and Brave are good examples of varieties having relatively long intervals between heading and anthesis. Stoskopf in his presentation mentioned this character as being an important contributing factor to yield.

In commenting on the reports on heterosis and the possibility of hybrid oats, C. F. Murphy stated that increase in yield over the best available variety and not the high yielding parent was most important.

At the end of the afternoon session Chairman Grafius requested suggestions from the Conference relative to a site for the next Oat Conference--probably in 1970. Beltsville, Md., and LaFayette, Ind., were discussed as possibilities. C. F. Murphy extended a tentative invitation for the Conference to hold their next meeting at Raleigh, N.C. Grafius mentioned the desirability of alternating between the North and South. It was left that the incoming Chairman and Executive Committee would consider the three locations and arrive at a decision well ahead of the next meeting of the Conference.

<u>Thursday Evening, February 10 --- J. E. Grafius</u>, Presiding ---

The Conference banquet was held in the Kellogg Center, starting at 6:15 p.m. After a nicely served and delicious meal, Professor Gordon E. Guyer, Head, Entomology Department, MSU, gave an illustrated address in which he discussed the highlights of the cooperative cereal leaf beetle research. Professor Guyer traced the spread of the beetle in the United States in 1962 from southwestern Michigan to most of lower Michigan, northern Indiana and Ohio, northeastern Illinois, and western Ontario. He described their attempt to find an effective natural parasite of the beetle and outlined their research programs on attractants, sterilization, varietal resistance, and low volume insecticides (mainly malathion). Adequate resistance to the cereal leaf beetle has been found among several pubescent wheat varieties and species. Not all pubescent types are resistant. Inheritance and breeding programs are already underway to incorporate this resistance to desirable agronomic types. Comparable resistance in barley or oats has not been found to date although some encouraging differences have been observed. The entire USDA World Collections of wheat, barley and oat varieties and species are being screened for sources of resistance and tolerance.

Following the banquet and address, everyone was taken on a tour where we had an opportunity to meet all of the individuals engaged in cereal leaf beetle research and to see their research studies in progress. The enthusiasm, knowledge and ability exhibited by these young workers were most impressive. We had an opportunity to observe striking differences in varietal reaction to the beetle, observe many new and clever techniques, and to learn some interesting facts about the behavior of the cereal leaf beetle on resistant and susceptible varieties.

Friday Morning, February 11 --- F. J. Zillinsky, Presiding ---

The session started promptly at 8:30 a.m. with M. E. McDaniel making the first presentation in the absence of I. M. Atkins. H. C. Murphy also made the presentations for R. T. Smith and H. C. Murphy because of the absence of Smith. Otherwise, all presentations were made in order and as scheduled, except that R. C. Frohberg replaced H. L. Shands as indicated earlier. (See Abstracts).

Before adjournment for morning recess, E. G. Heyne announced that a "Distinguished Service Award" had been bestowed by Kansas State University upon our former long-time Secretary, F. A. Coffman. This announcement was greeted with much applause.

Some of the key comments and answers to questions for the Friday morning session were as follows:

J. A. Browning suggested establishing an isolated central location where international cultures of extra virulent and avirulent races of rust might be tested and compared.

T. Rajhathy suggested that collections of *Avena sterilis* from northern Greece (Macedonia and Thrace) might offer the best sources of winter hardiness among the *A. sterilis* collections.

Question from Browning to Brown and Jedlinski: In view of the differential reactions you have described, do you expect resistance to BYDV will hold up? Answer: Since protection to BYDV is in the level of tolerance, it probably will last longer than a higher level of resistance.

Luncheon, Friday, February 11 --- J. E. Grafius, Presiding ---

The following resolution was moved by K. J. Frey and passed unanimously by the Conference:

"The members of the Oat Conference wish to express their appreciation and sincere gratitude to Drs. Grafius, Ellingboe and their colleagues for serving as our host and for arranging the wonderful facilities, tours, services, and warm weather, which have served to make this Conference the wonderful success that it has been."

Dr. Frey also moved, "That the Chairman of the Oat Conference appoint a Committee to formulate a plan for conferring Honorary Life Membership in the Oat Conference upon persons who have made significant and outstanding contributions to furthering oats as an agricultural crop." The motion was seconded and passed unanimously.

Friday Afternoon, February 11 --- R. M. Caldwell, Presiding ---

The last session of the Conference convened at 1:30 p.m. All presentations were delivered on schedule as listed in the program. (See Abstracts)

Because of lack of time, the need to get away for a tour of the MSU campus, or homeward bound, there were few questions asked at the conclusion of the Conference.

The Acting Secretary for the Conference would like to take this opportunity to sincerely thank all authors of presentations for their willingness to appear on the program, for their good presentations, and for the abstracts submitted for the Oat Newsletter. He would also like to thank all in attendance for their presence and good participation. It is a real pleasure to develop a program when everyone cooperates and assists as you did.

H. C. Murphy
Acting Secretary
National Oat Conference

## Program for National Oat Conference
## Michigan State University--Kellogg Center
## February 9, 10, 11, 1966

### Wednesday Morning - February 9

8:00 Registration, Conference Registration Desk, Lobby

Presiding - J. E. Grafius

8:30 Business Meeting - Announcements, introductions
8:45 Report of Acting Secretary - H. C. Murphy
8:50 Report of Editor of Newsletter - N. F. Jensen
9:00 Report of Committee on Genetic Nomenclature in Oats - M. D. Simons
9:15 Welcome - Sylvan H. Wittwer, Director, Agr. Exp. Station, M.S.U.
9:30 Uniform Oat Nurseries - H. C. Murphy
9:35 Western - F. C. Petr
9:40 Southern Winter - P. G. Rothman
9:45 Northern Winter - H. G. Marshall

9:50 DISCUSSION

10:00 RECESS

10:15 Effect of limited generation sequence on varietal release - N. F. Jensen, Cornell University

10:30 Status of multiline oat varieties in Iowa - J. A. Browning and K. J. Frey, Iowa State University

10:40 Relation of certain morphological characters and root lodging in oats - R. C. Frohberg, North Dakota State University (Exchanged with H. L. Shands--see 9:30 a.m., Friday).

11:05 Physiology of lodging resistance in oats - V. Burrows, Canada Department of Agriculture, Ottawa

11:30 The effect of lodging on the uptake and distribution of chemical elements in the oat culm - D. A. Ray and D. S. Bains, Ohio State University

11:45 DISCUSSION AND ANNOUNCEMENTS

Wednesday Afternoon - February 9

Presiding - A. H. Ellingboe

1:30 Current crown rust races in the United States - M. D. Simons, USDA and Iowa State University

1:45 Spread of crown rust in relation to resistance levels and composition of resistant host varieties - Brian Clifford, Purdue University

2:00 Late rusting character of Red Rustproof oats - H. H. Luke and D. T. Sechler, USDA and Florida Agr. Experiment Station (not given but abstract received).

2:15 Races of stem rust and sources of resistance - B. J. Roberts, USDA and University of Minnesota (presented by M. B. Moore)

2:30 Identification of races of oat stem rust - G. J. Green and John Martens, Canada Department of Agriculture, Winnipeg

2:40 Genes in oats for stem rust resistance - R. I. H. McKenzie, Canada Department of Agriculture, Winnipeg

2:55 DISCUSSION

3:05 RECESS

3:15 Linkage relations of the A, D, and F oat stem rust genes - F. L. Patterson, Purdue University

3:35 Relation of light intensity and rust resistance of oats in Colombia - J. A. Browning and Elkin Bustamente, Iowa State University

4:05 Transferring resistance to 6A and 13A from diploid to hexaploid Avena - F. J. Zillinsky, Canada Department of Agriculture, Ottawa

4:20 Oat breeding for a pathogen free area - M. L. Kaufman, Canada Department of Agriculture, Lacombe, Alberta

4:35 New seed treatments for control of oat smut - E. D. Hansing, Kansas State University

4:45 DISCUSSION

Wednesday Evening - February 9

Regional and special group meetings

Thursday Morning - February 10

Presiding - H. L. Shands

8:30 Nullisomic frequency in different genotypes - K. Sadanage, USDA and Iowa State University

8:50 Cytogenetics of oat species - T. Rajhathy, Canada Department of Agriculture, Ottawa

9:10 Chromosome affinities in oats - H. Thomas, Canada Department of Agriculture and Welsh Plant Breeding Station, Ottawa, and Aberystwyth, Wales

9:25 Compensating effect of certain homeologous chromosomes in triploid interspecific Avena hybrids - Ichizo Nishiyama, University of Wisconsin

9:45 Monosomics in Avena byzantina - R. M. Singh and A. T. Wallace, University of Florida

10:00 DISCUSSION

10:10 RECESS

10:25 Mutations at the Vb locus in oats - A. T. Wallace and H. H. Luke, University of Florida and USDA

10:40 Varietal and management forage studies utilizing livestock gains as a measure - M. J. Norris, Texas Substation No. 23, McGregor

10:55 The relationship of yield and protein content in oats - F. C. Petr, H. C. Murphy, and R. M. Wise, USDA and Idaho Experiment Station, Aberdeen

11:05 Fat acidity, a problem in oat varieties - D. E. Western, Quaker Oats Company

11:20 Heterosis in oats - F. C. Petr and K. J. Frey, USDA and Idaho Agricultural Experiment Station, and Iowa State University

11:35 Varietal reaction to toxiphene spray in oats - J. H. Gardenhire Texas Substation No. 6, Denton

11:45 DISCUSSION AND ANNOUNCEMENTS

Thursday Afternoon - February 10

Presiding - D. E. Western

1:30 The oat situation - H. C. Murphy, USDA, Beltsville

1:35 How to make profit-growing oats - Don Schrickle, Quaker Oats Company

1:55 Increasing oat yields under high fertility with shorter, stiffer-strawed varieites - R. M. Caldwell, Purdue University

2:10 Fertilizing oats for high yields - K. J. Frey, Iowa State University

2:25 Relation of nitrogen and population levels to oat yields - F. L. Patterson, Purdue University

2:40 Contributions of oat plant parts to grain weight - R. M. Shibles, Iowa State University

3:00 DISCUSSION

3:05 RECESS

3:15 Improving the nutritive value of oats - W. R. Graham, Quaker Oats Company (not presented due to illness of speaker)

3:30 Relation of seed quality to oat yields - D. Grabe, Iowa State University

4:00 Physiological and morphological aspects in cereals as related to yield - N. C. Stoskopf, Ontario Agricultural College, Guelph

4:30 Are hybrid oats the answer - F. L. Patterson, Purdue University

4:45 DISCUSSION AND ANNOUNCEMENTS

Thursday Evening - February 10

6:15 BANQUET - Highlights of Cereal Leaf Beetle Research, Professor Gordon E. Guyer, Head, Entomology Department

Friday Morning - February 11

Presiding - F. J. Zillinsky

8:30 The feral oats of Texas and Mexico and their possible value - I. M. Atkins and M. E. McDaniel, USDA and Texas A & M University

8:45 Use of wild species in oat improvement - H. C. Murphy, USDA, Beltsville

9:00 Controlling dormancy in Avena sterilis - R. T. Smith and H. C. Murphy, USDA, Beltsville

9:10 Breeding for rust resistance in Colombia - J. A. Browning and Elkin Bustamante, Iowa State University

9:30 A partial review of oat improvement in Rio Grande do Sul, Brazil - H. L. Shands, University of Wisconsin (Exchanged with Frohberg-- see Wednesday, 10:40 a.m.)

9:45 DISCUSSION

10:00 RECESS

10:15 Differentiation of three barley yellow dwarf virus strains by host reaction - H. Jedlinski and C. M. Brown, USDA and University of Illinois

10:45 Variation within aphid species in the transmission of barley yellow dwarf virus - W. F. Rochow, USDA and Cornell University

11:00 Specific transmission of an oat striate-type and of wheat striate mosaic viruses - H. Jedlinski, USDA and University of Illinois

11:15 Responses of winter oat varieties to fall vs. spring inoculations with BYDV - P. G. Rothman, USDA and Delta Branch Experiment Station, Stoneville, Mississippi

11:30 Studies on Septoria disease of oats - R. V. Clark, Canada Department of Agriculture, Ottawa

11:40 Environmental influence on the symptom expression of halo blight - R. D. Durbin, USDA and University of Wisconsin

11:50 DISCUSSION AND ANNOUNCEMENTS

Friday Afternoon - February 11

Presiding - R. M. Caldwell

1:30 Mass selection experiments in oat populations - K. J. Frey, Iowa State University

1:55 Breeding for increased winter survival in oats - V. C. Finkner, University of Kentucky

2:20 Effect of spring tillers on yield and yield components - Ronald Coffman, University of Kentucky

2:35 Use of controlled freezing tests in winter oat improvement - H. G. Marshall, USDA and Pennsylvania State University

2:55 *Helminthosporium victoriae* on oats: A basis for host-specificity and host resistance - R. P. Scheffer, Michigan State University

3:15 DISCUSSION

3:30 TOUR OF CAMPUS

## ABSTRACTS OF CONFERENCE PAPERS

### Wednesday Morning - Feb. 9

Report of committee on oat gene nomenclature -

The committee appointed by the chairman of the National Oat Conference to establish a standardized system of oat gene nomenclature has almost completed its assignment. A set of rules governing the form and assignment of oat gene symbols has been written. The literature has been surveyed, and all known genes have been given symbols in accordance with the rules. A total of about 170 genes were recognized. About one-half of those are concerned with reaction to disease organisms.

F. J. Zillinsky
N. F. Jensen
M. D. Simons (Chairman)

The Implications of the Limited Generation Seed Production Sequence to Varietal Release (Abstract) by N. F. Jensen, Cornell University -

The trend in cereal breeding is towards varieties of reduced height. Shorter varieties will magnify problems of crop uniformity and compliance with existing standards from the standpoint of increased visibility of mixtures and reproduction system abnormalities. To meet these problems it is anticipated that infusions of stocks at the Breeder Seed level may be needed oftener than in the past. This has led to the theoretically and practically sound shortening of the seed production cycle to the limited generation sequence of Breeder, Foundation, and Certified seeds. The elimination of the Registered class drastically changes the amounts and procedures involved in seed production. The talk is a consideration of these various related problems.

Status of the Iowa Multiline Variety Development Program by J. Artie Browning, K. J. Frey, Roger Grindeland and M. D. Simons; Iowa State University and USDA -

The Iowa Oat Improvement Program has since 1957 been directed toward the development of multiline varieties to buffer against losses from crown rust. Two recurrent parents have been used, an early oat, C.I. 7970 (from a Clinton-Garry cross made at Iowa State in 1954; it yields like Clinton but is 4 days earlier than Cherokee), and a mid-season oat, C.I. 7555 (a Clintland with stem rust resistance genes A and B). Twenty-six apparently different crown rust resistance genes are being incorporated into each of the two recurrent parents. The current status of this back-crossing program is shown in Table 1. Breeders' seed will be increased by the Committee for Agricultural Development in 1966, and the first blends of backcross lines for commercial production should be released in 1967. The number of different lines which will constitute the first blends is yet to be decided. Methods other than back-crossing to develop varieties of diverse origin also are being employed in parallel studies at Iowa State. These promise many benefits to growers other than just buffering against disease loss.

Table 1. Status of Isogenic Lines for Crown Rust Resistance Genes (1966) Growing Season)

| Source of resistance | Recurrent line | |
|---|---|---|
| | Early, C.I. 7970 | Midseason, C.I. 7555 |
| Bond | Breeders' seed | Breeders' seed |
| Santa Fe | - | Breeders' seed |
| Landhafer | Breeders' seed | Breeders' seed |
| Grey Algerian | $Bc_4$ $F_1$ | Cld 64 |
| Ascencao (V) | Breeders' seed | - |
| Ascencao (E) | Breeders' seed | Breeders' seed |
| Ascencao (?) | - | Breeders' seed |
| Ceirch duBach | Breeders' seed | Breeders' seed |
| _A. sterilis_ #7 | $Bc_6$ $F_3$ rows | Breeders' seed |
| _A. sterilis_ #2 | Breeders' seed | Breeders' seed |
| _A. sterilis_ #8-1 | - | Breeders' seed |
| _A. sterilis_ #8-2 | Breeders' seed | - |
| Trispernia | Breeders' seed | $Bc_6$ $F_3$ rows |
| Victoria (V) | Breeders' seed | - |
| Victoria (?) | - | Breeders' seed |
| P.I. 174544 | *$Bc_6$ $F_4$ plots | Breeders' seed |
| P.I. 174545 | *$Bc_6$ $F_4$ plots | Breeders' seed |
| P.I. 185783 | *$Bc_6$ $F_4$ plots | Breeders' seed |
| P.I. 267989 | $Bc_6$ $F_2$ plants | $Bc_6$ $F_2$ plants |
| Saia | $Bc_6$ $F_3$ rows | $Bc_6$ $F_3$ rows |
| Floriland | *$Bc_6$ $F_4$ plots | $Bc_6$ $F_3$ rows |
| C.I. 3030 | $Bc_6$ $F_3$ rows | *$Bc_6$ $F_4$ plots |
| Johnson | $Bc_6$ $F_3$ rows | *$Bc_6$ $F_4$ plots |
| Magnif 28 | $Bc_6$ $F_3$ rows | $Bc_6$ $F_3$ rows |
| Q (?) | Breeders' seed | - |
| Bondvic | $Bc_2$ $F_1$ | $Bc_2$ $F_1$ |
| Magistral | $Bc_2$ $F_1$ | $Bc_2$ $F_1$ |
| Ransom | $Bc_2$ $F_1$ | $Bc_2$ $F_1$ |

* 4-row plots in 1966 which will be bulked to produce Breeders' seed in 1967.

A Partial Review of Oat Improvement in Rio Grande do Sul, Brazil by H. L. Shands, University of Wisconsin -

The writer had the opportunity of briefly reviewing and, to a limited extent, participating in an oat improvement program in Rio Grand do Sul that was already in progress through the joint efforts of the University of Rio Grande do Sul, the Quaker Oats Company of Brazil, the Ministry of Agriculture (Federal) and the Secretary of Agriculture (State), and with cooperation of individual oat workers at several locations in the U.S.A.

Seed of segregating populations were provided by H. C. Murphy and workers from other locations. Rather large populations of Magnif 29 x Garland, Magnif 29 x Dodge and Magnif 29 x Burnett were grown at Passo Fundo and Pelotas. Most of the plants were examined individually by Brazilian workers including R. Dischinger, R. Bertholdi, Enrique Schreiner and the writer. Plants with lower crown rust infection were tagged, later to be harvested. A small amount of evidence of Helminthosporium victoriae was found at Passo Fundo and spores were identified with a microscope at Pelotas. The population of the cross Bage x Magnif 29 and the reciprocal had only a few plants that were susceptible to crown rust or partially susceptible, thus averaging a high level of resistance. Eleven crosses from Purdue were grown at Passo Fundo and Pelotas. C.I. 7921 was the crown rust resistance source for 4 crosses and A. sterilis, C.I. 8081, provided high resistance in 3 crosses. A few plants in segregating populations of Wisconsin origin were chosen for further study.

Some advanced selections from Wisconsin appeared to have adequate crown rust resistance, but it is expected that yellow dwarf might attack them. Two out of 6 advanced selections from Purdue were resistant to crown rust. Three advanced selections from Iowa grown at Centro Agronomico Experimental Farm had very promising crown rust resistance. Parentage involved was (1) A. sterilis and Landhafer, (2) A. sterilis gene and (3) Saia and Landhafer.

Advanced selections from several USDA nurseries were examined. Some oats of southern states breeding showed evidence of adaptation, but were lacking in adequate crown rust resistance.

Some of the local Brazilian selections appeared to have red leaf virus tolerance and a few had crown rust resistance; but most were weaker strawed than desirable.

In a mimeographed report by the writer, needs of oats for Rio Grande do Sul were listed; the needs being remarkably similar to those for the United States. Some of the local varieties of promise are Farroupilha, Bagé, I.A.S.2, Yellow Common, Magnif 29 and Pelotas 129. Several selections were listed for crosses that might be useful in Rio Grande do Sul.

Physiology of Lodging Resistance in Oats by V. Burrows, Canada Department of Agriculture, Ottawa

Breeding for lodging resistance is an important part of most cereal improvement programs. Although conventional methods of selection for resistance under field conditions have proven successful, experience has shown that such successes are few in number and require many years to accomplish. The major difficulty in selection for resistance centers around the fact that lodging is a quantitative character and, as such, is only best expressed by mass populations of plants grown in a confined land area. Up to the present time, efficient and easily applied techniques have not been devised to allow plant breeders to select single plants whose progeny will resist lodging when grown in dense stands.

Our objectives have been (a) to describe the lodging reaction in terms of the major climatic and physiological processes involved, (b) to determine what genetically controlled plant characteristics render a variety resistant to lodging, and (c) to develop simple and reliable growth-room and laboratory screening tests to select single seedlings for lodging resistance potential.

The lodging reaction of a cereal variety is intimately connected to the overall growth (duration of cell division of each meristem and subsequent expansion of cells) processes of each variety. Hence, all the environmental factors (water supply, nutrient availability, light exposure and temperature) that influence growth also modify the lodging reaction. We have found that the tissues of R varieties are <u>more compact</u> than the tissues of S varieties over a whole range of experimental conditions. For example, the coleoptiles, crown and aerial internodes, leaves and leaf sheaths, inflorescences and even seeds of R varieties tend to be shorter, thicker and wider than those of S varieties. This could be due to reduced cellular expansion or it may be due to the fact that fewer cells arise out of the activity of each meristem (apical and intercalary) in response to light. Some of our results suggest the latter conclusion to be correct especially when comparisons are made between very R and very S varieties. This may help to partially explain why S varieties tend to yield larger quantities of seed than do R varieties.

Several prediction or screening tests have been devised for plant breeders to use, in the laboratory and field, to select single plants (seed-dimension test, coleoptile expansion test, leaf-sheath elongation test) and mass populations of plants (seedling lodging test) for lodging resistance potential. We have used these tests to differentiate between R and S varieties of oats, spring and winter wheat, and spring and winter barley. A description of these tests together with supporting data will be presented.

<u>The Effect of Lodging on the Uptake and Distribution of Chemical Elements in the Oat Culm by Dale A. Ray and D. S. Bains, Ohio State University</u> -

The strength of straw and resistance to lodging in oats according to early studies was believed to depend upon the silica content and the lignification of the culm. Recent investigations have revealed that genetic factors, mineral nutrition, and atmospheric and soil conditions for plant growth are primary influences on the degree or severity of lodging. Information on the alterations in the chemical composition and in the distribution of the mineral elements associated with lodging of oat culms would contribute in explanation of the adverse effects produced in reduced yield and quality of grain and straw.

Using a split-plot design, a greenhouse experiment was conducted with three replications consisting of Rodney oat plants which at heading were subjected to induced lodging-angles of 0, 45 and 90 degrees with respect to the soil surface. In addition to a standard complete nutrient solution, nine fertility treatments consisting of a check plot and the eight combinations of 2 levels each of nitrogen, phosphorus and potassium were imposed. The oat plants were harvested 15 days after lodging had been induced and the above-ground portions of each plant were divided into samples representing the length above and the length below the culm internode at which the bending of the plant had been enforced. After having been oven-dried and ground with a Wiley mill, the plant portions were analyzed for 13 elements with a Recording Emission Spectrograph.

The phosphorus, iron, aluminum, molybdenum and strontium contents of oat culms were found to be directly related to increasing levels of fertilization, while the contents of calcium, copper, boron and cobalt were independent of the fertilizer treatments. Zinc, copper, and aluminum were in greater concentration in the lower culm portion than in the upper culm, while potassium, calcium, strontium, molybdenum, cobalt and boron were detected in greater amounts in the top portion of the plants. Lodging did influence a significant restriction in the distribution of copper, aluminum, zinc and strontium to give higher relative concentrations in the lower portions of the oat plant. The differential distribution of iron and sodium according to the degree of lodging was found to be related to fertility treatment.

## Wednesday Afternoon - Feb. 9

### Crown Rust Races in the United States by M. D. Simons, USDA and Iowa State University -

In the early 1960's crown rust race group 216, which parasitizes Victoria, but not Landhafer or Trispernia, made up almost one-half of the total isolates that were obtained from oats. Race group 290, which attacks Landhafer and sometimes Victoria but not Trispernia, accounted for about one-fourth of the total. Since then the relative prevalence of these two race groups has reversed, with group 290 now making up over one-half of all isolates and group 216 accounting for about one-fourth. Group 290 has been more common than group 216 among isolates from buckthorn almost since its discovery. In recent years very little group 216 has been found in collections taken from buckthorn. At present there is still no completely satisfactory source of seedling resistance to race group 264 among the hexaploid oats.

### Spread of Crown Rust in Relation to Resistance Levels and Composition of Resistant Host Varieties by Brian C. Clifford, Purdue University -

The epidemiology of *Puccinia coronata avenae*, race 294, was studied in 20' x 20' field plots of 4 "varieties" differing in resistance.

Varieties:

1) Purdue RA461A1-6-8-1. Designated as a slow rusting variety. Pustules are normal but reduced in number.
2) Cartier-CI2565. (Susceptible) + Purdue 5993B2-1-1-1 (0: reaction type) in a 50:50 mixture by number.
3) Purdue 5632C3-6P-3. Exhibits mature tissue resistance, and is moderately resistant at maturity.
4) Cartier-CI2565. Susceptible check variety.

Plots were replicated 4 times in a Latin square. Infected Cartier seedlings were transplanted to plot centers for the initial infection foci. Readings were taken at each of the 8 major points of the compass on 4 equally spaced radii in each plot. Readings were taken on 5 dates from June 14 to July 3. In the mixture, readings were taken on the susceptible component only. Readings were timed to coincide with potential disease increase as predicted from temperature and free moisture data. Readings were taken as coefficients of infection (Prevalence x Severity x Reaction Type).

The results showed significant differences in disease incidence between varieties and between locations (radii) within a plot at a given time and also within varieties and locations at different times. Rust build-up during the experiment was relatively slow, thus gradients within plots were not obliterated by an explosive outbreak of rust.

The rate of intensification and spread in the slow ruster was significantly less than in Cartier throughout the season.

Purdue 5632C3-6P-3 reacted similarly to Cartier during the early stages of build-up but exhibited significantly lower levels of disease by June 21. This reflected the ontogenetic nature of this resistance-type.

The Cartier in the mixture behaved in a way comparable to that in pure stand with regard to intensification at the smallest radius during the experiment but the rate of spread to the plot periphery on Cartier in the mixture was somewhat reduced reflecting the buffering ability of the resistant component.

The Late Rusting Character of Red Rustproof Oats by H. H. Luke and D. T. Sechler, U.S.D.A. and The Florida Agricultural Experiment Stations -

Although the term "Red Rustproof" is a misnomer, it has been known for more than a century that signs of rust infection occur about three weeks later on Red Rustproof types than on susceptible varieties. To the knowledge of the writers, no one has investigated the late rusting phenomenon; therefore, a study was initiated to determine the fundamental nature of this character. Another objective was to determine whether or not the late rusting character could be incorporated into improved agronomic types. If the latter objective could be reached, then it would be possible to develop a new approach (rust escaping varieties) to the genetic control of rust diseases of oats.

Since early observations indicated that the late rusting phenomenon was related to maturity date, several Red Rustproof types with different maturity dates were selected. Fulghum and C.I. 3934 were used as early maturity types, Burt as an intermediate type and Red Rustproof 14 as a late type.

Observations suggested that, under field conditions, changes in host physiology during the reproductive phase predisposed the host to infection. In order to study this possibility, varieties exhibiting different maturity dates were planted on October 15 and continued at monthly intervals through January 15; therefore, early, intermediate and late maturing types would be at various stages of maturity when natural rust infection occurred. This type of test has been conducted over an eight year period and three consistent observations have been made.

1) Although late maturing varieties exhibit "significant-rust-infection" (more than 10%) two to three weeks later than early maturing types, the late types showed a similar degree of rust infection at all stages of growth; thus changes in host physioloby *per se* does not explain the late-rusting phenomenon.

2) The intermediate maturing variety (Burt) was not intermediate when percentage of rust infection was plotted against time of infection, but reacted like early maturing types (Fulghum and C.I. 3934). Thus there is no relation between maturity date and date of rust infection when intermediate and early maturing varieties are compared.

3) The late rusting Red Rustproof types consistently exhibit a lower percentage infection under field conditions than early rusting types. Therefore, late rusting types have two protective devices (late rusting and low percentage of infection) against crown rust.

Since changes in host physiology, during the heading phases, did not explain the late rusting phenomenon and since Red Rustproof varieties become infected under greenhouse conditions, it appeared that environmental factors (temperature, humidity, light, etc.) may influence infection. Therefore, the varieties mentioned above were inoculated under growth-chamber conditions at all stages of growth at 70, 80, and 90° F and maintained at the temperature at which they were inoculated for 12 days. All varieties at all stages of growth and at the temperatures tested were heavily infected. In view of these results, an attempt to more closely emulate field conditions was made by conducting an experiment similar to the growth-chamber test (temperature was not controlled) under field conditions. Inoculations were carried out under moist chamber conditions and were initiated immediately following the first observation of natural infection (3/23/61). Again all varieties at all stages of growth exhibited signs of infection. The late maturing types, however, were infected primarily on the leaf tips and lower leaves. In addition, uredia on the late rusting varieties turned to telia three to five days following sporulation whereas the early rusting types sporulate profusely; suggesting that under certain environmental conditions, the host does exert a physiological response to crown rust infection.

In summation the late rusting phenomenon is not simple but is apparently conditioned by an intricate interaction between environment and host physiology. Results also suggest that temperature and light are perhaps the most important environmental factors. Different approaches (microclimate, pre and post inoculation, physiology, light and temperature effects) are being made to solve the interesting problem.

Preliminary observation of $F_2$ populations, indicate that maturity date and date of rusting are not completely linked.

Races of Stem Rust and Sources of Resistance by B. J. Roberts, USDA and University of Minnesota -

During the past three years 23 races of oat stem rust, *Puccinia graminis* var. *avenae*, have been identified from the uredial and aecial collections made within the United States. These 23 races represent different combinations of virulence for the resistance controlled by genes A, B, D, E, F, and H. The relative prevalence of the races in 1965 were: 6AF, 40%; 6F, 34%; 7A, 7AF, and 12A, 5%; 7 and 12, 3%; 2 and 5, 3%; 4A, 6A, 6AFH, 13A, and 13AF, 11%. Races of the last group occurred primarily in the northeastern states.

Two new races, race 6AFH and 13AF, were identified in 1965. Race 6AFH attacks varieties with genes A, B, D, E, F, H, and various combinations of these genes. Race 13AF attack oats with genes A, B, D, and F.

Race 6AF is of major importance because it became the most prevalent race in 1965, and because it attacks virtually all varieties grown commercially. Hexaploid oats resistant to 6AF can be subdivided into 4 groups based on the reaction of seedling and adult plants: (a) seedling and adult plants resistant, examples C.I. 5844, 7110, 6851, 6968, 8156, and selections of

C. I. 7114 and Ctn x Ark; (b) seedlings resistant but adult plants ranging from moderately susceptible to susceptible, examples C.I. 7908, 7637, 7889, 6792, 6558; (c) seedlings susceptible and adult plants resistant, example C.I. 3034; (d) seedlings mesothetic and adult plants susceptible, example $Ctn^2$ x Ark C.I. 6643. Genes A, B, D, E, and F have not conditioned seedling or adult plant resistance to isolates of 6AF collected in the northcentral United States.

Seedling of selections of Kyto are highly resistant to 6AFH and highly resistant races 6A, 6F, 6AF, 12A, 10A, and 13A. The resistance of both selections was not expressed at approximate temperatures of 75 and 85 F.

Identification of races of oat stem rust at Winnipeg by G. J. Green and J. Martens, Canada Department of Agriculture, Winnipeg -

Difficulties in naming races of oat stem rust have become critical at Winnipeg in the last few years. Our main problem with the present "Race" system is its inflexibility. New differential host varieties have had to be used as supplementary hosts to the standard set and virulence on them designated by letters or gene symbols appended to the race number. Numbers such as 6AFH are cumbersome and the use of additional letters as new resistance genes are discovered will make them unsuitable for general use.

A system of "Virulence Formulae", used at Winnipeg for the last three years, has solved many of the problems of the "Race" system. In the "Formula" system effective genes that confer resistance are listed as a numerator and ineffective genes that do not confer resistance are listed as a denominator, e.g. BH/ADEF. As virulence combinations are found the formulae for them are numbered consecutively. The advantages of the system are: 1) Flexibility. Differential host varieties may be added or removed. 2) Conciseness. A culture is identified by a single, simple number. 3) Completeness. All available information on the pathogenicity of a culture can be shown in the formula. 4) Simplicity. Formulae numbers are easily assigned and a register of formulae easily maintained.

Genes in Hexaploid Oats for Stem Rust Resistance by R. I. H. McKenzie, G. J. Green and J. W. Martens, Canada Department of Agriculture, Winnipeg, Manitoba -

The earliest studies of stem rust resistance carried on about 1920 at Minnesota and Iowa were with two distinct groups of rust resistant oat varieties. One group had a gene that was later designated as "A" that gave resistance to races 1, 2, 3, 5, 7 and 12. The other group was found to have a different gene later designated "D" that gave resistance to races 1, 2, 5, 8, 10 and 11.

These genes were believed to be allelic for many years but in 1950 they were combined at Minnesota. It was thought the combination was accomplished either because the two genes were pseudo-alleles or else due to unequal crossing-over resulting in a tandem duplication of two alleles.

In 1937 Welsh found another gene in Hajira which gave resistance to all known races. This gene was designated "B". Gene "E" was also known many years ago and conferred good resistance to races 1, 3, 4, and 11. In 1959 resistance to race 6A and a number of other virulent races was found in Hajira and in some Kherson selections. This gene designated "F" was found to be closely linked in repulsion to genes "A" and "D", but eventually was combined with these genes. More recently resistance to races 6F and 6AF has been found in a number of varieties of diverse origin and the gene conferring this resistance has been designated as "H".

Gene "H" has been found to be allelic or closely linked to gene "E" in the repulsion phase. Moreover "H" is either linked in the coupling phase or pleiotropic for both stem rust resistance and the Ukraine type of crown rust resistance. Likewise stem rust resistance conferred by gene "E" has not been separated from crown rust resistance after 5 backcrosses.

The important genes for stem rust resistance in hexaploid oats appear to be in 3 allelic or tightly linked groups. Since hexaploid oats have 3 genomes this would cause one to speculate that each group might be in a different genome. Fortunately we seem to be able to combine these genes, so that if in the future more genes are found at these 3 loci they might also be combined.

With the appearance since 1958 of a continuous stream of ever more virulent rust strains it is important that new genes for rust resistance be found quickly. Four methods offer some hope: 1) Screening the U.S.D.A. or similar collections of oats for rust resistance. 2) Screening collections of wild hexaploid oats particularly from areas where stem rust is common. 3) Transfer of genes for stem rust resistance from diploid and tetraploid species. 4) Irradiation and mutation.

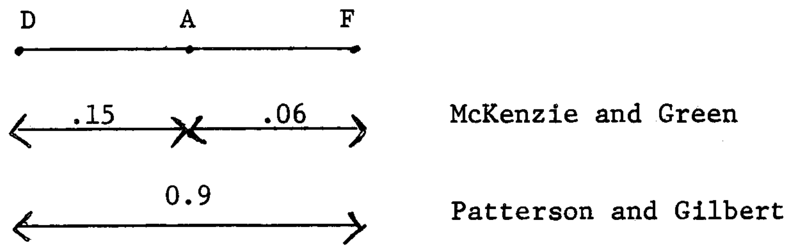
<u>Linkage Relations in the A-D-F Region by F. L. Patterson and S. K. Gilbert, Purdue University</u> -

The chemical mutagen, diepoxybutane, was used in an attempt to create new resistance to stem rust in Clintland (<u>D</u>) oats. Four variant types, resistant to races 7 and 7A, were found in 2 families. The variant resistances were similar to gene <u>A</u> in Newton in reaction to races 6, 7, 7A and 8. Additional tests by B. J. Roberts, Cooperative Rust Laboratory, University of Minnesota, has shown the 2 variants (grouped by families) to possess a gene similar to gene <u>A</u> for reaction to a number of isolates of races 2, 5, 6A, 6F, 6AF, 7A, 8A, 8AF, 10A and 13A of oat stem rust. The <u>D</u> gene resistance was lost.

Genetic studies were conducted to determine the locus of the variant resistances. Crosses were made of the variants with varieties with genes <u>A</u>, <u>B</u>, <u>D</u>, or <u>F</u>. Seedling reactions were studied in the $F_2$ and $F_3$ in the greenhouse with races 7 and 7A. In crosses with gene <u>D</u> varieties, resistance of variants behaved as a simple dominant in $F_2$ and $F_3$. In crosses to type <u>BD</u>, the resistance to race 7 of the variant and <u>B</u> were independent. In crosses to Cartier (susceptible) resistance of the variants was inherited as a simple dominant. In crosses of the variants with resistance <u>A</u> or <u>AB</u> no segregation occurred in $F_2$ or $F_3$. In crosses of variant 2 with Kherson 27 (<u>F</u>), tested to race 7, all $F_2$ plants were resistant but in the $F_3$ segregation of susceptible plants occurred in 3 of 167 families.

Assuming the susceptible plants are true recombinants the resistance of the variant was estimated at 0.9 crossover units from gene <u>F</u>. The gene order <u>A</u>, <u>D</u> and <u>F</u> has not been established. Koo <u>et al</u>. reported <u>A</u> and <u>D</u> were closely linked in the coupling phase in C.I. 7098. McKenzie and Green in an analysis in the repulsion phase estimated that <u>A</u> and <u>D</u> were about .15 units apart and <u>A</u> and <u>F</u> .06 units apart.

Since the resistance of gene D, present in Clintland, was lost in the variants, the variant resistance is most logically a mutation from D to A at the Dd locus. Thus:




An alternative hypothesis is that mutations occurred at 2 loci, D to d and a to A'. The possibility that the variant resistance is type A in an off-type plant in the original Clintland variety cannot be completely examined. Progenies of other tillers of the original 2 treated plants involved did not produce seed in the severe BYV epidemic in the first year.

References: Koo, F. K. S., M. B. Moore, W. M. Myers, and B. J. Roberts. 1955. Inheritance of seedling reaction to races 7 and 8 of *Puccinia graminis avenae* Eriks. and Henn. at high temperature in three oat crosses. Agron. J. 47:122-124.

McKenzie, R. I. H., and G. J. Green. 1962. Further studies on the genes in oats for resistance to stem rust. Can. J. Genet. Cytol. 4:394-401.

The Effect of Light Intensity on the Reactions of Oat Seedlings to *Puccinia graminis avenae*. J. A. Browning, Elkin Bustamante, Juan Orjuela, and H. D. Thurston, Iowa State University and Instituto Colombiano Agropecurario, Colombia -

The interaction between the oat stem rust differential variety, Minrus, and races to which Minrus normally is considered resistant, is light sensitive. Minrus and other varieties which contain gene D give a susceptible type $3^{\pm}$ or even type 4 reaction to rust cultures at high light intensities to which they give a resistant type $2^{\pm}$ reaction at medium and low light intensities. Identification of oat stem rust races at upper elevations and, therefore, high light intensities, results almost exclusively in identification of Minrus-virulent races. Varieties containing gene F also are light sensitive. However, Richland (gene A) and Rodney (gene BC) are not light sensitive, and Jostrain (gene E) probably is not. It is necessary, therefore, to control light intensity as well as temperature to identify races accurately and determine probable genotypes of rust collections, or to determine probable genotypes of breeding material being tested with known races. Light intensity alone does not yet adequately explain adult plant reactions to stem rust in the field in Colombia.

Problems associated with the transfer of stem rust resistance from diploid to hexaploid oats by F. J. Zillinsky, Canada Department of Agriculture, Ottawa -

Screening is done on advanced generations of hexaploid progenies derived from pentaploid hybrids of autotetraploids of *A. strigosa* x *A. sativa*. The early generations were reproduced under conditions where outcrossing is likely.

It is therefore important that genes of diploid origin are distinguished from those present in hexaploid varieties. If screening is to be effective, the diploid genes should have a similar influence in both diploid and hexaploid genotypes. Crown rust resistant genes Pc. 15 and Pc. 23, transferred from _A. strigosa_, C.D. 3820 to _A. sativa_, were isolated and identified by using two key races of crown rust - 264 and 294. Resistance to smut, which appears to differ from that occurring in common varieties, was isolated from hexaploids of interspecific origin using smut races 251 and 369. Screening for stem rust resistance controlled by diploid genes is complicated by the failure of dominant genes to express resistance in the pentaploid and presumably in the hexaploid condition. Plants with combined resistance to 6A and 6AF were selected from populations of interspecific origin and were used in crosses to _A. sativa_ strains having A, B, F, and H genes for resistance. Although $F_2$ segregation was observed in crosses with varieties having the F gene, observations on the hybrids and segregating populations are rather discouraging.

1) The $F_1$ hybrid plants had considerable sterility. One group having a common parent of interspecific origin had 10 out of 18 plants partially sterile.

2) The resistance to 6A did not appear to be associated with resistance to 6AF as expected for the _A. strigosa_ gene for stem rust resistance.

3) Resistance to stem rust occurred in populations of derived hexaploids which had some sterility.

Among the more encouraging observations was the resistance to stem rust in the presence of races 6A, 13A, 6AF, 4A and 7A of one pentaploid hybrid, C.D. $3820^2$ x I.N. 865. I.N. 865 is a hexaploid interspecific derivative.

Oat Breeding for a Pathogen Free Area by M. L. Kaufmann, Canada Department of Agriculture, Lacombe, Alberta -

A new oat breeding method was initiated at Lacombe in 1960. It was prompted by the shortcomings of the pedigree and modifications of the pedigree method in breeding for improvement of characters of complex inheritance. Diseases are not a problem in the area concerned. The method involves "random sampling" through the segregating generations, a technique developed at Ottawa. When virtual homozygosity is reached, plant lines are increased for yield tests. Random sampling is carried out by taking one seed from each plant in each generation starting in the $F_2$ and using this seed to propagate the next generation. The $F_6$ plant lines are increased for yield tests. Arbitrarily, about 300 lines are being processed from each cross.

There are many other details being carried out partly to evaluate the method and partly to make use of the random lines to obtain information on traits of complex inheritance. Seed of plants in each generation is kept and identified so that each line can be traced back through each generation to the $F_2$. This is done so that specific traits can be studied if desired. For example, if a line is lacking in grain quality but is otherwise superior we can go back with a view to selecting for quality without losing other desirable characteristics. The large number of random lines also makes possible a thorough study of the association of yield and the three components of yield. It also makes possible a comparison of crosses for various characteristics.

The first field results from rod-row-plots were obtained in 1964. From data compiled to date, it appears that transgressive segregation is involved in the inheritance of grain quality (kernel plumpness and test weight) maturity, and perhaps lodging resistance. The next step is to correlate these features with yield.

One disadvantage of this method is the volume of material going into yield tests. Experiments have been and continue to be conducted to find less laborious methods of yield testing than are now being used. Prime consideration is being given to the use of non-replicated tests with frequent check plots in the preliminary round of selection for yield.

New seed treatments for control of oat smut by E. D. Hansing, Kansas State University -

During the last 15 years fungicides which have been evaluated extensively and then recommended as seed treatments of oats are as follows: Panogen 15 (2.2% methyl mercury dicyandiamide. 1.5% Hg), Chipcote 75 (1.85% methyl mercury nitrile. 1.5% Hg), Ortho LM (2.25% methyl mercury 8-hydroxyquinolinate. 1.25% Hg), Ceresan L (2.89% methyl mercury, 2,3-dihydroxy propyl mercaptide & 0.62% methyl mercury acetate. 2.25 total Hg), and Memmi (10% N-methyl mercury-1,2,3,6-tetrahydro-3, 6-endomethano-3,4,5,6,7,7-hexachlorophthalimide. 3.4% Hg). All of these are organic mercuries in liquid carriers. They have given comparable control of oat smut when each has been applied at a rate of 0.01125 ounces of metallic mercury per bushel of seed.

Ceresan M (7.7% ethyl mercury p-toluene sulfonanilide. 3.2 Hg) which was recommended about 20 years ago was applied at 0.016 ounces of metallic mercury per bushel of seed to obtain the same control of oat smut.

In addition to more effective fungicides from the standpoint of application, progress has been made towards safety in use of Agricultural Chemicals.

## Thursday Morning - Feb. 10

Nullisomic frequency in different genotypes by K. Sadanaga, USDA and Iowa State University -

Monosomics A-F of Cherokee, produced by X-radiation, have been maintained through selfing. Monosomic C of Cherokee, that when selfed produces about seven per cent nullisomics, when crossed to standard Cherokee (non-irradiated) and to Garry, showed an increase in the frequency of nullisomics. The nullisomic frequencies observed for one to three generations of crossing to standard Cherokee denoted by 37, $37^2$, and $37^3$ were 8.8%, 18.4%, and 50%, respectively. The frequency of nullisomics for one to three generations of crossing to Garry denoted by 38, $38^2$, and $38^3$ were 40.0%, 28.1%, and 33.9%, respectively. Monosomic F, which upon selfing has not produced any nullisomics, showed an increase in the frequency of nullisomics, not so much in hybrids with standard Cherokee or to Garry, but in hybrids with C.I. 7451, Markton, and C4 (alboviridis).

Cytogenetics of Oat Species by Tibor Rajhathy, Canada Department of Agriculture, Ottawa -

Oat species can be divided into three groups by their chromosome numbers and into six groups by their karyotypes. The three distinct diploid karyotypes

($A_p$, $A_s$, $A_l$) and a modified $A_p^v$ of ventricosa are reproductively isolated and each has a definite pattern of ecological adaptation and geographical distribution. Differences in chromosome end-arrangements were found in the $A_p$ population. Major and minor structural differences of the chromosomes built up isolation barriers between the diploid karyotypes.

The genomes of the tetraploids can be designated as $A_sB$ and those of the hexaploids as $A_sCD$. The polyploids cytologically behave like diploids, but the presence of extensive genetic duplications is indicated by the tolerance of chromosome deficiency. Species with the same karotypes are interfertile, interkaryotype and interploid hybrids are sterile. Two mechanisms, chromosomal differentiation and alloploidy, can be recognized to be most important in the phylogenesis of oat species. In view of evidence at hand only one species deserves specific rank in each karotype group, thus the number of oat species would be reduced to six, of which four are diploids, one tetraploid, and one hexaploid.

Chromosome Affinities in Oats by H. Thomas, Canada Department of Agriculture, Ottawa -

The frequency of multivalents in the 8x amphiploid *A. hirtula* - *A. sativa* was found to be much lower than the theoretical expectation based on accepted genomic designation. Over 90 percent of the chromosomes were associated as bivalents. The predominantly bivalent pairing of the amphiploid can be accounted for by preferential pairing and hence chromosomal differentiation between the A genome chromosomes of *A. hirtula* and *A. sativa*, or possibly by a genetic system analogous to that located on chromosome 5B of common wheat. Chromosome pairing in the backcross hybrids *A. hirtula* - *A. sativa* (8x) x *A. sativa* was $21_{II} + 7_I$, with the seven *hirtula* chromosomes remaining unpaired. From a second backcross to *A. sativa* and on selfing the first backcross hybrids, 53 plants with the chromosome number of 43 (i.e., the *sativa* complement plus a single *hirtula* chromosome) have been isolated. These addition lines provide an unique opportunity of studying affinities at the chromosomal as opposed to the genomic level in the *Avenae*.

Since some pairing was recorded between the added *hirtula* chromosome and their homologous pair of *sativa* chromosomes in the addition lines, a low proportion of recombinants is expected in the progeny. A breeding programme aimed at utilizing such recombinants in gene transfer from wild diploid species to the cultivated hexaploid species of *Avena* will be discussed.

Compensating Effect of Certain Homoelogous Chromosomes in the Progeny of Triploid Interspecific Avena Hybrids by Ichizo Nishiyam, University of Wisconsin -

Based upon the results of cytological investigations, the mode of chromosome pairing in $F_1$ hybrids between *Avena strigosa* (2x) and *A. barbata* (4x) is interpreted as follows (Nishiyama 1934):

| Species | Genome | Chromosome pairing | | | | | | |
|---|---|---|---|---|---|---|---|---|
| _A. strigosa_ | A | 1a | 2a | 3a | 4a | 5a | 6a | 7a |
| _A. barbata_ | A | 1a | 2a | 3a | 4a | 5a | 6a | 7a |
| | B' | 1b | 2b | 3b' | 4a' | 5a' | 6a' | 7a' |

Formation of closely paired bivalents

——— or ----- Formation of trivalents

In the present paper are given the genetic behaviors of 4a' and 5a' which are in compensation for 4a and 5a, respectively, in the progeny of the triploid hybrid.

Ia. Trisomic-5a' (2x+5d, having 5a' in excess) usually segregated trisomics with disarticulated florets and diploids with non-disarticulated florets, but a few diploids with disarticulated florets were rarely found. This inheritance may be understood by assuming that 5a' carries a major gene for disarticulation of florets and 5a carries a gene for non-disarticulation. It is noteworthy that all disarticulated diploids segregated non-disarticulated florets (5a 5a) and disarticulated florets (5a 5a'); disarticulated homozygotes (5a' 5a') evidently were lethal (Nishiyama 1934). However, a homozygous strain for disarticulation (5a'-1 5a'-1) was found in a later generation; 5a'-1 shows 5a' having lost lethal factors.

Ib. On the other hand, there was found a tetraploid segregate which was like _A. barbata_ with an exception of a new type of the spikelet character which was similar to that of _A. sterilis_ and called "steriloid". All of the steriloids were heterozygous, segregating steriloids and disarticulated florets which bred true in the following generation. Since $F_8$, however, there were further found a few of non-disarticulated spikelets in addition to two kinds of segregates mentioned just above. When the non-disarticulated spikelets were crossed with disarticulated ones, $F_1$ hybrids showed the steriloid type of spikelets and gave non-disarticulation: steriloid: disarticulation in a ratio of nearly 1:2:1 in $F_2$. These genetic features suggest that steriloids have a chromosome constitution 5a5a, 5a5a' instead of 5a5a, 5a'5a' of disarticulated florets or _A. barbata_. Non-viable non-disarticulated spikelets could have 5a5a, 5a5a and viable ones could have 5a5a, 5a-1; 5a-1 having lost a lethal factor on 5a, probably due to crossing over between 5a and 5a'.

Ic. Similar genetic behavior of the steriloid character was observed in the progeny of monsomics (4x-1) with a chromosome constitution 5a5a, 5a'0. In this case, non-disarticulated spikelets were never observed, because of the elimination due to non-viable combination of chromosomes, or nullisomics (5a5a, 00). Thus the steriloid character is induced by a dose rate of 2:1 or 3:1 between 5a and 5a', while disarticulated spikelets are caused by the ratio of 1:1.

II. The author found a similar genetic behavior for 4a' which was in compensation for 4a in diploid segregates. 4a' carries genes for velvety pubescence and light brown color of lemma which are dominant to gene for glabrous and gray lemma respectively, located on 4a.

Trisomic-4a' (2x+4a') segregated usually trisomics with hairy, light brown lemma and diploids with glabrous, gray lemma. However, a few diploids showed hairy, light brown lemma. All of the diploids with hairy, light brown lemma were heterozygous, homozygotes being non-viable.

In the meiosis of PMC's, 4a' and 5a' were able to pair closely with 4a and 5a, respectively, and no abnormal behavior was observed. However, these chromosomes might be differentiated with each other, probably in minor structure. These structural changes effect the zygotic lethal in two dose compensation for their homoelogous chromosomes. Occasional crossing over could occur between them, although much suppressed and lethal factors could be lost, resulting in the complete compensation between two homoelogous chromosomes.

Monosomics in Avena byzantina by R. M. Singh and A. T. Wallace, University of Florida -

By karyotype analyses and breeding behavior investigations the critical chromosomes in five monosomes of the Victorgrain variety of oats were given genomic designations using the system suggested by Rajhathy (Can. J. Genet. Cytol. 5:127-132).

Nullisomic plants in monosomes 213-3-1 and 221-7-8 showed asynapsis and desynapsis, respectively. Absence of the critical pair in nullisomics of monosome 213-3-1 caused the pairing failure of all the chromosomes in the early prophase and influenced the movement of chromosomes at anaphase I. Thus at anaphase I, 28 chromosomes in groups of 14 each, moved to opposite poles, leaving 12 univalents in the middle of the pollen mother cell, whereas in nullisomics of monosome 221-7-8, loose chromosome pairs were observed in the early prophase, but by late prophase or metaphase I only 0 to 9 II were left and the rest of the pairs formed univalents. The movement of the chromosomes was opposite to that described for nullisomic 213-3-1. Thus 14 chromosomes in groups of 7 each moved to opposite poles, leaving 26 univalents in the middle of the pollen mother cell.

From these observations it is suggested that the critical chromosome in monosome 213-3-1 is from the A genome. It controls the pairing of all the chromosomes, but more specifically of 14 chromosomes from the A genome, whereas critical chromosome in monosome 221-7-8 controls more specifically the later steps in the pairing process of 28 chromosomes from the C and D genomes.

From morphological and cytogenetical studies genes for gray seed color production and fertility were placed on the short arm of M-3, genes controlling normal pairing and normal leaf width placed on ST-7, another gene for normal pairing on the short arm, and genes for inhibition of fatuoid characters, crooked rachis bases and yellowish leaf spots placed on the long arm of the critical chromosome in monosome 221-7-8, and genes for normal maturity and floret base color placed on ST-17 in monosome 473-6-6.

The gene vb controlling the resistance to fungus *Helminthosporium victoriae* M & M was not associated with the critical chromosomes in any of the monosomic lines tested.

Mutations at the Vb Locus in Oats by A. T. Wallace and H. H. Luke, University of Florida and USDA -

By the use of a mass screening program, Luke, et al. (Phytopath, 50: 205-209. 1960 and other references) reported the isolation of 72 spontaneously occurring mutants exhibiting full resistance to *Helminthosporium victoriae*. Two of these mutants exhibited an intermediate reaction to *H. victoriae* toxin and a necrotic response to certain crown rust races. The necrotic response to crown rust, however, was similar to but not exactly like that of the parental variety.

More recently, a total of 175 induced mutants that exhibited full resistance to *H. victoriae* toxin have been purified for use in genetic studies. 84 of these were produced by ionizing radiations and chemicals, and two occurred spontaneously. In addition, 40 mutants, partially resistant to toxin, were isolated from chemical and ionizing radiation treated populations. These 40 exhibit a range of toxin resistance reactions and a range of necrotic responses to crown rust. Although genetic studies on only two of the partial resistant mutants have been completed, these results and the $F_2$ data from 450 crosses involving 69 full-resistant induced mutants indicate that all are located at the same locus.

The objectives of the induced mutation program and the mass screening program were to obtain mutations giving full resistance to toxin. The data collected, however, does indicate that partial resistant mutants could be isolated with ease. These results suggest that with sensitive screening techniques, a full spectrum of mutations at the *Vb* locus in oats can be isolated. In addition, the induced mutation results suggest that the full spectrum of mutations that occur spontaneously at the *Vb* locus, can be induced with mutagenic agents. If the *Vb* locus can be considered to be representative of other loci in higher plants, then one could expect that induced mutations can be of potential use for plant breeders.

Oat Varietal and Management Forage Studies Using Livestock Gains as the Indicator by M. J. Norris, Texas A & M University -

Grazing trials were conducted on oat varieties having distinctly different growth habits. The varieties and their growth habits included: Alamo-X, an upright growing spring type; New Nortex, a semiprostrate type; Bronco, a prostrate winter type. Three stocking rates were used on each variety. Grazing results with beef steers indicate stocking rates have more influence on animal performance than varieties. The upright growing variety, Alamo-X gave the highest animal gains per acre but varietal differences were small.

The Relationship of Protein Content and Yield of Oats by F. C. Petr, H. C. Murphy and Martin Wise, USDA and University of Idaho, Aberdeen -

A study was conducted to determine the relationship of the percentage protein content and grain yield in oats. Twenty varieties were chosen from the world collection of oats to provide a wide range in protein content (based on results of previous evaluation of the collection). The oats were grown at Aberdeen and Twin Falls, Idaho, in 1962 to 1964 in replicated 4-row plots ten feet long. The two center rows were harvested to determine yields and samples of replication composites were analyzed for protein content using the Kjeldahl procedure. In 1962, the protein analysis was made of both dehulled and unhulled oats resulting in a correlation of +.74, so groat samples only were used in 1963 and 1964. The association of protein content and groat yield per acre was determined, as well as that between protein content and pounds of protein per acre. Correlations were also obtained on the same attributes of the entries in the Northwestern regional oat nursery and for groups of selections from three crosses. Protein content of groats and grain yield had an average r value of -.77 for 200 samples from the 20 varieties, and protein content and groat yield were also negatively correlated with an average r of -.74. The uniform entries had average correlations of -.83 for protein content and grain yield. Correlations of protein content of groats and grain yield averaged -.41 for 174 selections representing three crosses.

The results showed a negative correlation exists between high protein content of oats and grain yield. Except under unfavorable conditions the negative correlation is relatively stable from season to season and at different locations. Oat breeders will have to consider this unfavorable correlation in breeding programs to improve protein content of oats. Breeding for high protein yields per acre may prove to be more practical. Screening the wild species of oats may identify new sources of genes for high protein content with a more favorable association with high yield.

Fat Acidity -- A Problem in New Oat Varieties by D. E. Western, The Quaker Oats Company -

We are hearing more and more about fat acidity in oats. The fact is, in recent years, our nutrition people maintain that some of our oats are running excessively high and have established a limit of 7% for groats to be used in the making of rolled oats and for oat flour to be used in oat ready-to-eat cereals and baby foods. More than 7% is objectionable from a flavor standpoint; it is not nutritionally harmful.

Perhaps we should first define fat acidity. Free fatty acids are extracted with the fat, and calculated as oleic acid. Apparently various molds are a cause, producing enzymes which split the fats causing an increase in the free fatty acid. There is a definite correlation between free fatty acid and flavor. When the fatty acid approaches 7%, there develops an off flavor.

Before we can eliminate, or at least decrease the effect of high fat acidity, we first need to know how these various molds accumulate and develop to the degree that flavor is affected. We have long known that oat groats cannot be stored for any length of time above 13.0% moisture without drying to prevent mold growth. Normally, in good bright oats, the outer hull protects the groat from oxidation and enzymes have no chance to develop provided moisture in the oats is below 13.0%.

In recent years, our Research Laboratory had noted that any dark groats, regardless of how they got that way, were excessively high in fat acidity. We have always stayed away from purchasing badly weathered oats because the groats would become stained, making for too many off-colored flakes in our rolled oat product. In such cases, our tasters would also complain of off-flavor. In recent years, our oat millers, as well as our people at the Research Laboratory, have found more and more of these dark groats, showing up in our product and with a corresponding high fat acidity.

We have concluded that our short plump oat varieties do not have enough hull covering. In other words, the lemma and palea are not long enough; the plump groat is exposed and becomes easily accessible to weathering and also to oxidation. Many ground molds are prevalent in the fields and get an easy start for their development, particularly in areas where farmers wind-row their oats. Mold spores have been found in oats with high fat acidity.

We at Quaker are somewhat responsible for at least a portion of the trouble in that we encouraged the selection of these varieties with nice plump kernels and a low hull percentage, as it greatly enhanced our milling yields. Apparently, in this decision, we may have been somewhat penny-wise and pound foolish. Now that the problem has developed and since we at least know some of the causes, we have noted while looking at rod rows of new selections, at various experiment stations, that some not only have a large plump groat but also are very well covered by a nice long lemma and palea. We have noted that most Clinton derivatives have an excellent hull covering, and incidentally, they have been one of our best milling oats. Apparently, they have a very thin hull. Perhaps we can have our cake and eat it, too, by proper selection of early generation material for a thin long lemma covering of the groat and yet have a long plump groat.

This should not be any great problem since we have already seen many selections which appear excellent. Nearly every experiment station has access to one of our small experimental oat-hulling machines. Those who do not have a machine and who want their selections run for hull percentage, can make arrangements for having the work done by contacting the "Leader of Oat Investigations" at Beltsville, Maryland.

Just as soon as a new selection has been advanced far enough so that a station can spare five pounds, we urge that a sample be sent to the Director of Grain Development, The Quaker Oats Company, Chicago, Illinois, for a complete milling test. Our milling test will give nutritional values as well, including protein, fat, fiber on groats, and some other characteristics, such as color of the grain, etc. It will also give the plant breeder an idea as to how they might grade at the market place. Five pounds of oats may seem a large quantity, particularly in the early stage of the development of a new variety, but all that we can say is that 25 years ago, to get the same results, we required 50,000 bushels.

Heterosis in Oats by F. C. Petr and K. J. Frey, USDA, Iowa State University and University of Idaho, Aberdeen -

A study was conducted to determine the degree of heterosis in the $F_1$ and $F_2$ generation of oat crosses when grown in space-planted nurseries. The $F_1$'s of 15 oat crosses and the parental varieties were planted in a randomized complete block experiment with 3 replications at Aberdeen, Idaho, in 1955. Five plants subjected to uniform competition (sown one foot apart) were harvested in each $F_1$ or parental plot. Measurements were obtained for heading date, number of panicles per plant, number of spikelets per primary panicle, plant height, and grain yield per plant. The $F_2$'s and their parents were grown at the same location in 1957. A 4-inch spacing was used for the $F_2$ progeny and their parents in rows one foot apart, and measurements were made for the same attributes as in the $F_1$.

The grain yields of each $F_1$ exceeded the highest yielding parent. The degree of heterosis expressed in the $F_1$ ranged from 101 to 130% of the high parent with a mean heterosis of 112%. Cody x Roxton and Cody x Andrew were highest yielding crosses while the crosses involving Victory were the lowest in yield. In the $F_2$ some of the crosses exceeded the high yielding parent and the mean $F_2$ heterosis relative to the high yielding parents was 99%. For one cross the yield of the $F_2$ was 120% of the high parent, suggesting the possibility of using the $F_2$ seed for commercial production.

Heterosis was expressed for number of panicles per plant and the $F_1$ was earlier in heading then the mid-parent. Except in a few crosses, plant height and number of spikelets per panicle in the $F_1$'s and $F_2$'s closely approximated the mid-parent values.

The correlations between $F_1$'s and $F_2$'s and their respective mid-parental values for number of spikelets per panicle, plant height and heading date were highly significant and above 0.89. For yield, similar correlations were 0.60.

## Thursday Afternoon - Feb. 10

### The 1965 Oat Crop by H. C. Murphy, USDA -

A record oat yield of 50.2 bushels per acre was obtained in the United States in 1965 despite an average delay of about 2 weeks in spring seeding in the major oat-producing areas. This record yield was five bushels above the previous high of 45.2 bushels obtained in 1963 and was produced on 19,106,000 acres, the smallest acreage since 1882. Total production of 959.2 million bushels in 1965 was up nine percent from 1964, but eight percent below average. Except for North Dakota, which showed an increase, and South Dakota, which was unchanged, all States in the heavy-oat-producing North Central Region showed a continued decrease in oat acreage. Had seeding not been delayed by a late spring and wet conditions, the decrease in acreage might have leveled off or even increased. World oat acreage continued to decline in 1965, although there were a few significant reversals in countries such as Canada.

There was a striking increase in U.S. oat yield and steady decline in oat acreage during the past 12 years. Eight of the 10 highest oat yields recorded in the United States, to date, were obtained during this period. Oat yields and harvested acreages for the past 12 years have been as follows:

| | Yield | | | |
|---|---|---|---|---|
| Year | Bu. | All-time rank | Harvested acres (000) | Remarks |
| 1965 | 50.2 | 1 | 19,106 | Record yield, delayed spring seeding |
| 1964 | 43.1 | 6 | 20,419 | Delayed spring seeding |
| 1963 | 45.2 | 2 | 21,683 | Record yield, delayed seeding |
| 1962 | 45.0 | 3 | 22,675 | Record yield, delayed seeding |
| 1961 | 42.2 | 7 | 23,994 | Delayed spring seeding, winter killing |
| 1960 | 43.4 | 5 | 26,646 | Delayed spring seeding |
| 1959 | 37.6 | - | 28,368 | BYDV |
| 1958 | 44.5 | 4 | 31,834 | Record yield |
| 1957 | 37.5 | - | 34,646 | Crown rust |
| 1956 | 34.5 | - | 34,984 | Drought in Midwest |
| 1955 | 38.3 | 8 | 39,243 | Record yield |
| 1954 | 35.4 | - | 42,291 | Some rust damage |

A loss of about one bushel per day in yield for each day delay in spring seeding is an axiom in oat production. Two record and three near record U.S. oat yields have been obtained during the past 6 years when seedings have been delayed 10 days or more in the heavy producing spring oat areas. These unexpected high yields could be explained in part by unusually favorable late season weather, general freedom from major diseases, and the improved disease resistance and possibly better adaptation of the new varieties now being grown.

How to Make the Most Profit Growing Oats by Donald J. Schrickel, The Quaker Oats Company -

The top oat producers in our major oat-producing regions are getting yields in the 100 bushel per acre category, and with these yields there is money to be made raising oats. Competition from other crops can be met successfully in many areas if all factors are considered.

What have top producers done in Iowa this past year? In our Vocational Agriculture projects conducted primarily in the eastern one-third of Iowa, we required students to have a minimum five-acre field in which one acre was selected for yield checks. Yield figures were supervised and checked by Vocational Agriculture instructors. The top 31 students averaged 106 bushels per acre. They represented 22 different school districts. Twenty participants had yields of 100 bushels per acre of higher. The top individual yield was 135.6 bushels per acre, the second highest yield was 134.7 bushels per acre, and there were two participants with 134 bushels per acre.

We recognize the fact these do not represent carefully controlled yield checks such as might be conducted by a state university. Instead, they represent what we consider producer-type yield checks under everyday farm conditions in the Midwest.

During 1965, we also conducted farmer demonstration fields -- 22 fields in 16 different locations in eastern Iowa. The size of the fields averaged 26.8 acres and varied from 12 to 45 acres. Several of these fields were in an area subjected to severe storms and consequent lodging of the oats. This resulted in lower yields than might have been harvested in these areas. In addition, despite supervision, there were several cases of poor management which hurt individual yields considerably. With these factors in mind, our average on the fertilized fields were still 91 bushels per acre and in ten of the 16 locations, yields were 100 bushels per acre or higher.

We feel that these Vocational Agriculture projects and farmer demonstrtion fields have removed any doubt that oat yields can be pushed to the 100 bushel per acre category without too much difficulty.

What practices do we recommend to get these maximum yields? Briefly, we recommend some fall preparation of the land. Oats usually follow corn in our major oat-producing territory, and we suggest that stalks be chopped in the fall and the field double disked. This permits fields to dry out early in the spring and allows early spring planting, which is most important. We recommend a soil analysis to determine fertility requirements, and in most cases, this means addition of nitrogen in an available form in order to get quick growth in early plant stages, plus phosphate and potash according to needs. Normally, much of the nitrogen which shows up in the soil analysis is tied up in the decomposition of corn stalks during the early part of the growing season. Drilling of the oats is preferred to broadcast seeding. A seeding rate of about three bushels per acre of top quality seed of a recommended variety is suggested. We urge that seed be tested for germination, cleaned, and treated. All of these factors are important, but we think the availability of nitrogen for early plant growth is the most important single factor.

In order to meet the competition of other crops, oats have to be profitable, and 100 bushel per acre yields <u>are</u> profitable. In our demonstration areas, we can properly use 65¢ per bushel as the market value, and this means a gross return of $65.00 per acre plus the value of the straw. We use a minimum straw value of $20.00 per acre, but in the areas where straw is in demand, this value is frequently higher. In any event, we have a total gross return per acre of $85.00, which permits us to compete favorably with soybeans, for example, at $2.40 per bushel yielding 35 bushels per acre. This would amount to a gross return of $84.00 per acre and we think we are being fair in our comparison as 35 bushels per acre represents considerably more than the average yield of soybeans in our major oat-producing regions.

There are other reasons why oat production is being encouraged other than the net return per acre. The rolling land areas subject to erosion cannot be planted to row crops consistently without problems. The establishment of seedings for hay and pasture are important to many operators. In addition, the serious disease and insect problems showing up in row crops in much of our major oat territory seem to point to the advantage of natural control, which can be accomplished by placing oats in the rotation.

All of these factors, topped by good management, are bringing about renewed interest in producing oats and in making money by doing so.

<u>Increasing Oat Yields Under High Fertility with Shorter Stiffer Strawed Varieties by R. M. Caldwell, F. L. Patterson, J. F. Schafer and L. E. Compton, Purdue University Agricultural Experiment Station</u> -

Much progress has been made in the standing ability of the corn-belt oat varieties, beginning with the introduction of the Bond germplasm and the development of the Clinton oat variety. Clinton was followed by its derivatives, the extensively grown Clintland, Newton, Goodfield and Garland varieties. Previous to the availability of these varietis, only limited use could be made of commercial fertilizer of high nitrogen content on the predominant Kherson type (60-day) varieties because of weak straw and the lodging hazard.

With the advent of the stronger strawed varieties of the Clinton type, nitrogenous fertilization was stepped up in the corn belt areas. However, lodging was still a hazard if yields reached the 75-100 bu/A. level. It seems obvious today that both spring and winter oats, to compete in the rotation on fertile soils of the corn belt area and no doubt in other areas, must produce at levels well above 100 Bu/A. under good cultural conditions.

Even casual observation suggests that poor seed bed preparation and careless seeding of the spring oat crop has commonly resulted in inadequate stands. Correction of these factors and the use of maximum fertilization, within the range of profitability, and inherently high yielding varieties will be necessary to bring the spring oats into a competitive position with available alternative crops in the corn belt.

Experience at Purdue has shown that the higher yielding, available, commercial spring oat varieties will not consistently stand up on heavily fertilized soils where the contemporary winter wheat varieties stand under yields of 70-80 Bu/A. It therefore seems clear that along with emphasis on the development of varieties having the ability to respond in yield to high fertility, intensive effort must be directed toward improved ability to hold up high grain yields until harvest.

Up to this point most straw improvement beyond the Clinton level has resulted from fortunate, but unpredictable transgressive segregation. Examples are the Goodfield, Garland, Tippecanoe and Tyler varieties. In the Purdue program we have made attempts to breed for straw improvement directly by extensive hybridization of our best adapted and most productive lines with short and stiff-strawed parents.

The most promising progress has come from progenies of many crosses with the Welch variety, Milford, which is wholly unadapted in Indiana but contributed remarkable standing ability and grain quality to its hybrid progeny. The first crosses were made in 1953. The dense compact head of Milford was found to be simply inherited and closely associated with stiff and usually short straw in hybrid populations. Better strawed segregates were therefore rather easily identifiable in bulk segregating populations.

In using the rigidly stiff straw of Milford type, the problem of root lodging is accentuated. The rigidly stiff-strawed types require very strong root anchorage to resist root lodging. In severe storms greater force is exerted on the root anchorage of the rigid-straw lines than on those with yielding "whippy" straw. Wide differences in root anchorage have been observed among the apparently equally stiff-strawed lines. It has been possible to select rigid-straw types capable of resisting root lodging under severe storm conditions. One of the earlier crosses produced the recently-released variety, Clintford, improved in yield, quality and straw-stiffness over the parent Clintland. Its straw strength is equal to the best to come from our program thus far in the variety Tippecanoe. The panicle is only medium dense and the straw correspondingly is not as strong as many segregates having the dense head, characteristics of Milford.

"Backcrossing" of the lines with the dense panicles and extremely stiff straw to superior, disease-resistant, and productive agronomic types has resulted in a large breeding nursery where both disease resistance and superior straw are being selected for. In 1965, 160 Milford derivatives were grown in advanced and preliminary performance tests. Fortunately, these tests were at the highest yield levels ever attained in Indiana, and under extreme testing of straw strength in volent thunder showers. The highest yielding line in the test, Garry. ~~Rex~~ CI 8172, a Canadian variety, produced 163 Bu/A. The highly productive adapted variety Brave 37 produced 139 Bu/A.

The high yielding ability of the Milford derivative, Clintford, having the moderately dense head had previously been demonstrated, but the yield of the stiffer strawed dense-headed derivatives obtained in the early phase of the program had been less than hoped for. Clintford produced well again, in 1965, at 132 Bu/A. Most encouraging was the productivity of a considerable number of dense-headed lines that produced up to 148 Bu/A. on straw as short and stiff or stiffer than that of Goodfield or Tippecanoe which yielded only 106 and 104 Bu/A respectively.

We believe, therefore, that we may be assured that introduction of the Milford type straw is not necessarily accompanied by loss in yield, and that hopefully we may be approaching the required high-yielding, stiff-strawed type that appears essential for continued profitability of the oat crop on productive land in the corn belt and adjacent areas.

Fertilizing Oats for High Yields by D. A. Whitney and J. T. Pesek, Iowa State University -

Various combinations of nitrogen, phosphorus, potassium and lime have been applied annually to continuous oat plots for 3 years (1963-65) at 5 experimental sites (representing 5 major soil types) in the major oat-growing areas of Iowa. The experimental sites were fall-plowed and spring tillage was limited to that necessary to secure a good seedbed. All plots were drilled with seed of Dodge variety in 1963 and Garland in 1964 and 1965, at 3 bushels per acre. Ranger alfalfa was seeded with the oats and forage stand estimates were made 2 weeks following oat harvest after which 2, 4-D was used to kill the seedings.

There was no detectable response in either oat grain or straw yields from the application of lime and the response to potassium was small. Applications of 30 pounds of nitrogen raised grain yields by as much as 12 bushels per acre (from 76 to 88) when averaged across all 15 experiments and nearly 20 bushels per acre at individual sites. Rates of nitrogen above 30 pounds per acre added some yield, but they would probably not be economical in practice. Phosphorus applications of 20 to 30 pounds per acre also in creased grain yields 12 bushels per acre.

Straw yields were increased 0.5 tons per acre (1.2 on 0-0-0 vs 1.7 on 30-30-45) by moderate applications of nitrogen and phosphorus.

Relation of Nitrogen and Population Levels to Oat Yields by F. L. Patterson, J. F. Schafer, R. M. Caldwell and L. E. Compton, Purdue University -

Observations in Indiana suggest that the oat crop is at a much lower population than desired for maximum production. Oats normally follow corn in rotation. The use of higher populations in corn results in poorer seed beds and lower stands of oats generally. The additional stalks make nitrogen availability more difficult to adjust for in fertilization. Finally the increased use of pre-emergence chemicals on corn results in a carryover effect on oats, especially rate of growth and tillering. Farmers who follow soybeans with oats have generally superior oat crops by avoiding these major problems.

The two major problems, population and nitrogen nutrition, are interrelated by way of tillering. We have been doing research on populations and/or response to nitrogen for the past 11 years at Purdue University. New stiff-strawed varieties increase the interest in high production levels.

All research has been on oats following wheat in rotation on a dark brown silty clay loam soil. Residual nitrogen availability has been estimated at 25 lbs/A. The nitrogen added has been 25, 50 or 100 lbs/A of N in the form of ammonium nitrate. The populations have been 15, 25, 35 and 45 plants per square foot in nursery yield trials.

The experiments may be grouped into 3 phases. In the first phase the response of 7 varieties was studied at 4 populations and with 25 lbs/A added nitrogen for 3 years, 1955, 1956, and 1959. The major question was whether new large-seeded varieties like Putnam should be seeded at a higher rate than Mo. 0-205. The seeding rates for the 2 varieties to get the 4 population levels in 1955 were: Putnam - 40, 67, 93 and 120 lbs/A and Mo. 0-205 - 29, 49, 68 and 88 lbs/A. In these 3 years the differences fo- yield among varieties were significant, the differences among the 3 highest populations were not significant and the interaction of varieties by populations was not significant. The total number of panicles increased with population level. Mean yields for populations ranged from 90 to 122 bu/A in these years.

In the next 3-year phase, 1961 to 1963, only nitrogen level was studied using the 35 plants/sq. ft. population. Twenty-five varieties, chosen for straw strength, were tested the first 2 years and 4 less in the third year. Differences among nitrogen levels were not significant for yield. Varieties were significantly different. Nitrogen influenced tillering very little. The number of panicles per plot was lower than in the previous study of populations suggesting that populations were not high enough.

In the third phase, 1964 and 1965, populations and nitrogen level studies were combined using 8 varieties. These included Mo. 0-205, Clintland 60, 5 derivatives of these (including Tippecanoe and Tyler) and AuSable. In 1964 yields averaged 73 bu/A and did not respond to nitrogen or population. In 1965 yields averaged 108 bu/A and did not respond to nitrogen level but did respond to population level. The highest yield was obtained from the highest population where no tillering occurred.

These studies suggest that for a variable spring climate like Indiana that we cannot depend on tillering to produce the dense stands needed for maximum yields. It appears that we have a similar situation as for corn. We should plant the population we want without depending on tillering. In breeding we need to select for ability to produce a good panicle under high populations. The selection against barrenness in corn at high populations has been successful.

<u>Contribution of Oat Plant Parts to Grain Weight by V. K. Jennings and R. M. Shibles, Iowa State University</u> -

The photosynthetic contribution of heads, leaf sheathes, flag-leaf blade and other leaf blades to grain yield was determined for two oat genotypes of differing morphology, A-465 (large-glumed; "droopy" leaved) and Goodfield (small-glumed; short, upright leaves). Contribution to yield was assessed by shading or removing the various parts and determining the magnitude of increase in grain dry weight over a 17 day period.

Sugar analysis of the vegetative tissue revealed that only 2-3% of the grain weight accumulated during treatement could have been derived from translocation of pre-treatment photosynthate; i.e., essentially all of the grain weight changes during treatment were due to immediate photosynthesis.

Photosynthesis in the head, leaf sheathes, flag-leaf blade and other leaf blades accounted for 63%, 15%, 18% and 4% of the increase in grain weight in A-465 and 38%, 26%, 10% and 26% in Goodfield. The greater contribution of A-465 heads is due to its having about 75% more glume area than Goodfield. The larger size of the flag-leaf probably accounts for its greater contribution in A-465 than in Goodfield. The higher contribution of leaf sheathes and other leaf blades in Goodfield is believed to be due to the influence of plant structure on solar radiation interception. The short, upright leaf blades of Goodfield favor penetration of more solar energy to lower leaves than do the large, "droopy" leaves on A-465. These preliminary results suggest that morphology may be an important consideration in a yield selection program.

Relation of Seed Quality to Oat Yields by D. F. Grabe, Iowa State University -

Reductions in oat yields from planting seed lots with reduced germination and vigor were studied in 2 experiments over a 3-year period.

The first experiment was conducted to determine the effect of germination levels on yield. Fifteen samples of Nemaha oats were obtained from farmer's seed stocks. These were chosen to provide three lots each averaging approximately 95%, 85%, 75%, 65%, and 55% germination. These lots were placed in yield trials in one location in 1962, two locations in 1963, and three locations in 1964. The 3-year average results are shown in Table 1.

Table 1. Yields, stands of plants and seedling vigor from Nemaha oat seed lots with varying germination percentages (six tests during 1962-1964).

| | Germination percentages | | | | |
|---|---|---|---|---|---|
| | 97 | 86 | 76 | 67 | 56 |
| Yield, bushels per acre | 76 | 70 | 68 | 67 | 70 |
| Stand, plants per sq. feet | 27 | 24 | 20 | 17 | 18 |
| Vigor, seedling root length in millimeters | 67 | 56 | 53 | 53 | 56 |

Seed lots averaging 86% germination and lower yielded approximately 10% less than seed lots averaging 97% germination. Part of the yield reduction was attributed to lower vigor of the seedlings from the lower germinating lots.

A second experiment was conducted to study the effect of seed vigor on oat yields. Seeds of Clintland 60, a low tillering variety, and Missouri 0-205, a high tillering variety, were hand planted at 2", 4", 8", and 16" spacings. Seeds of three levels of vigor-high, medium, and low, were planted. Average yields from two years of tests are shown in Table 2. In nearly all cases, low vigor seed yielded less than high or medium vigor seed. This occurred in both varieties and at all spacings. Plants grown from the low vigor seeds produced fewer tillers, fewer seeds, and smaller seeds.

These studies show that oat yields can be reduced by two different aspects of seed quality - reduced germination and reduced vigor. The major effect of low germination is to produce thin stands. The lower vigor that often accompanies low germination also may contribute to lower yields. Reduced vigor also reduces yields when stands are adequate.

Table 2. Yields of oats from seed with high, medium and low vigor (2 tests during 1964-65).

| Vigor level of seed | Variety | |
|---|---|---|
| | Clintland 60 | Missouri 0-205 |
| | (bushels per acre) | |
| High | 87 | 94 |
| Medium | 84 | 89 |
| Low | 80 | 86 |

Physiological and Morphological Aspects in Cereals as Related to Grain Yield by N. C. Stoskopf, J. W. Tanner, and E. Reinbergs, Department of Crop Science, Ontario Agricultural College, Guelph, Ontario -

The objective in cereal production is higher grain yields. This may be obtained through physiological and morphological aspects that increase the duration of photosynthesis and its rate per unit area; and by increasing the duration of the filling period.

The rate of photosynthesis per unit area may be increased by reducing mutual shading of leaves so as to have a maximum leaf area above the compensation point. This can be accomplished by narrower leaves and by having leaves disposed at a steep angle, accompanied by a satisfactory planting pattern.

Increasing the duration of the filling period even at the expense of the vegetative period, and to have the filling period corresponding with the best light conditions should be useful in increasing yield. By reducing the vegetative period and increasing the filling period improvements in the grain to straw ratio may be realized. If an optimum leaf area index coincided with anthesis, a high rate of photosynthesis for grain falling could occur in all green leaves through to senescence. Non-tillering types in spring cereals may be potentially useful if this is to be achieved.

Close attention to collectively evaluating any of these attributes is essential if interactions between leaf angle, plant size and plant population are to be evaluated and cereals are to achieve high potential grain yields.

Preliminary data from tests in Ontario will be presented to support these theories.

Are Hybrid Oats the Answer? by F. L. Patterson, Purdue University -

Utilization of commerical hybrid oats would permit the use of the additional variability associated with non-additive gene action. We need a workable genetic-cytoplasmic system for pollination control, adequate cross pollination, and enough hybrid vigor to make hybrids economically feasible. If interest in commercial hybrids can be sparked by preliminary research, a great deal more research money should become available from public agenices and from private agencies. This has been demonstrated recently for wheat.

The nullisomic female parent and monosomic commercial hybrid was suggested recently (by LaFever and Patterson) as a possible pollination control mechanism. The nullisomic female was to be fertile in one environment to maintain seed stocks and male sterile in another for making hybrid seed. In controlled climate studies the Purdue Clintland 60 nullisomic ranged from 0 (at 80°F) to 55% (at 60°F) seed set. Early research (1959) suggested that the nullisomic was low in seed set at Lafayette, Indiana (1.3%). This value, as measured by bagged panicles, was 8.3% and 15.1% respectively for the Clintland 60 nullisomic in 1964 and 1965.

The question still remains of whether or not the amount of cross pollination in oats is high enough to make seed production practical. Our measurements are on nullisomic plants. With Clintland 60 nullisomic female, cross pollination averaged 11.7% for 5 pollinators in 1959, 11.4% for 10 pollinators in 1964, and 9.9% for 10 pollinators in 1965. Cartier and Mo. 0-205 have been superior pollinators. Seed set under open pollination has been quite similar to seed set from mutual bagging in glassine bags of one nullisomic panicle with one panicle of the pollinator.

We have done some research to determine if other varieties might be superior to Clintland 60 as the nullisomic parent. Six varieties were crossed to the Clintland 60 nullisomics and the $F_2$ generation nullisomics were studied for seed set with the variety as the pollinator for the $F_2$ nullisomics and as pollinator for the $F_2$ generation of Clintland 60 nullisomic X Clintland 60 as a check. About 83% of the $F_2$ plants were expected to be nullisomic, 16% monosomic and 1% disomic. The latter two units furnished some pollen in addition to the pollinator. In separate isolations seed set ranged from 26 to 46% for Clintland 60 nullisomics with the 6 pollinators and from 26 to 61% on the six $F_2$ populations. Of the six crosses the $F_2$ nullisomics involving Mo. 0-205 and Burnett were superior to the Clintland 60 nullisomics. This gives encouragement that better female lines may be developed.

The final question is one of the relative amount of hybrid vigor in oats. Several examples of hybrid vigor for yield have been cited but nearly all have been based on a very few spaced plants. No one has yet demonstrated in a good yield trial that a vigor level of 20 to 30% or more, necessary for commercial oats, is available.

One would predict that a cytoplasmic male sterility and restorer system might be found in oats as has been found in wheat, sorghum and corn. We need this mechanism to get extensive tests on hybrid vigor in the disomic condition.

Finally one would hope that research in hybrid vigor would encourage increased research on the nature of gene action and on the variability within crosses.

Friday morning - Feb. 11

The Feral Oats of Texas and Mexico and Their Possible Value as Germ Plasm Sources by I. M. Atkins, J. H. Gardenhire and M. E. McDaniel, Texas A & M University and USDA -

Oats have probably been grown in Texas since the first settlers came from Eastern States and may possibly have been brought in by Spanish missionaries at even earlier dates. The recorded history has not been fully explored for references on growing of cereal crops. Wheat was grown north of Dallas as early as 1833, and it is probable that oat mixtures were imported with this seed. Growing of wheat in Mexico dates back into the 1500's and undoubtedly oat mixtures were present in this seed, if indeed, oats were not grown as a crop. The first recorded census of agriculture in Texas shows 300,000 acres of oats as early as 1880.

The great diversity of the feral oats which grow along roadsides, in fencerows and even in fields has been observed by the senior author during more than 35 years of research in Texas. Recently an opportunity to study these oats more fully has developed. Approximately 2000 samples have been collected from Texas and northern Mexico during recent years.

During 1962-63 approximately 600 were tested for reaction to races 2, 6, 7, 7A and 8 of stem rust. From 28 strains which showed resistance to one or more races, 11 were tested for reaction to races 6F and 6AF by B. J. Roberts and D. A. Freter of the St. Paul Rust Laboratory. The 28 strains were included in the 1965 Puerto Rico rust tests with races 6A and 6AF. Strains ranging from typical _Avena fatua_ types to near cultivated types have been isolated with resistance to one or more races of stem rust. Some appear to be typical to known genes in reaction but others appear different. Three strains, picked up at Grandview, Texas all were resistant to race 10A yet one was a true fatua, one an intermediate near fatuoid and one a near cultivated type. Two strains with a high type of adult plant resistance to race 6A were isolated in the Puerto Rico tests but these are susceptible to race 6A in the seedling stage.

Crown rust races 216, 264, 276 and 294 were used to test the same group. Dr. M. D. Simons has checked these results. A total of 23 strains were resistant to race 276 only, 49 were resistant to races 276 and 294 and only 2 resistant to race 216. As an example of the types represented among resistant lines, those resistant to race 276 included 8 brown fatuas, 1 white fatua, 7 white seeded fatuoid type, 1 red oat derivative, 5 yellow seeded near cultivated types, 1 Mustang derivative and 1 small black seeded oat. Most of these strains were resistant to Victoria blight.

Approximately 600 strains were classified for growth habit. A total of 496 were decumbent, 40 intermediate and 15 had spring habit seedling growth. Approximately 150, which appeared hardy, were tested at Denton and Bushland, Texas and at Stillwater and Woodward, Oklahoma. Average survival of Alamo checks was 10%, of New Nortex 45%, of Mustang 50% and Bronco 85%. Sixteen feral strains had an average survival of more than 75% with 2 above 90%. It is interesting that of these 16 hardy strains, 8 were true fatua types. Promising forage type have been observed among these. Four hundred strains were tested for greenbug reaction by J. H. Gardenhire but no resistance was found.

_Use of Wild Species in Oat Improvement by H. C. Murphy, USDA, Beltsville_ -

For the first time in the history of oat improvement, a wealth of widely diversified wild oat species germplasm is becoming available to oat workers. Canadian and Wales oat scientists collected 540 samples of 6 wild oat species in 1964 from 15 countries in the Mediterranean Region. Detailed information about the Canadian-Wales wild oat species collection has just been published:

"A collection of wild oat species in the Mediterranean Region" by T. Rajahathy, F. J. Zillinsky, and J. D. Hayes, Ottawa Research Station, Canada Department of Agriculture.

Large numbers of samples of Avena sterilis and other oat species are being collected in Israel, with many being tested for reaction to race 264 of crown rust and to race 6 of stem rust before they are forwarded to Beltsville for inclusion in the USDA World Oat Collection. The collecting and testing of wild oat species in Israel is being accomplished by Drs. I. Wahl, A. Dinoor, and their associates under a USDA P.L. 480 project.

The number of samples of each wild Avena species listed by the Canadian-Wales workers and the approximate number received to date by the USDA from Israel are summarized below:

| Species | 2N | Number of samples | |
|---|---|---|---|
| | | Canadian-Wales | Israel-USDA |
| clauda | 14 | 35 | - |
| pilosa | 14 | 15 | - |
| ventricosa | 14 | 2 | - |
| longiglumis | 14 | 11 | 2 |
| strigosa | 14 | - | 3 |
| wiestii | 14 | - | 3 |
| barbata | 28 | 301 | 278 |
| sterilis | 42 | 176 | 1318 |
| Total | | 540 | 1604 |

One or more seed increases are usually required before there are adequate amounts for distribution of wild oat species collections. Shattering and seed dormancy complicate the collection and increase procedures. Seed of the Israel-USDA collections is being increased as rapidly as possible.

As indicated in the 1964 Oat Newsletter (page 8) A. sterilis and Rhamnus palaestina have been growing in proximity to each other in northern Israel for a long time. With this opportunity for natural selection for tolerance and for all levels of resistance to crown rust, and the absence of any barberry species, one would expect to find more resistance to crown rust than to stem rust. This expectation has been confirmed in the screening for resistance to the "264 group" of crown rust races and the "6 group" of stem rust races in Israel and at Beltsville. More than 200 selections of A. sterilis possessing seedling resistance to 264 or 276 of crown rust, and about 40 selections possessing resistance to 6, 6A, and 6AF of stem rust have been found to date. Differential reactions to different races and subraces indicate the presence of several new genes for rust resistance.

A high degree of variability, expressed both as heterogeneity and heterozygosity, has been ovserved in the Israel A. sterilis collections. This variability has been observed for a large number of charcters, including reaction to crown and stem rust, maturity, height, habit of growth, kernel and foliage pubescence, kernel and groat size and shape, vigor and foliage color and erectness. The hexaploid A. sterilis collections would appear to represent a rich source of new and potentially valuable genes for disease resistance and desirable agronomic characters that can be readily incorporated into desirable agronomic types.

It would seem logical for oat breeders to fully exploit the readily usable variability present among the many collections of the hexaploid A. sterilis before attempting the much more difficult task of transferring desirable genes from the tetraploid and diploid species.

Controlling Dormancy in Avena sterilis by R. T. Smith and H. C. Murphy, USDA, Beltsville -

Kernels of the wild hexaploid oat *Avena sterilis* are dormant practically from the time of fertilization to an average of 6 months after they shatter from the panicle. Using freshly harvested kernels, a large number of possible dormancy-controlling physical and chemical treatments were investigated. Four of the treatments found most reliable for breaking dormany (in order of efficiency) were:

First treatment: Dehulled, pricked primary and secondary kernels, immersed in 95 percent ethanol for 3 minutes, germinated 97 percent and 71 percent, respectively.

Second treatment: Dehulled, pricked primary and secondary kernels, immersed in 100 ppm gibberellin - 95 percent ethanol solution for 3 minutes, germinated 91 percent and 87 percent, respectively. Dehulled primary and secondary kernels that were not pricked germinated 21 percent and 24 percent, respectively.

Third treatment: Dehulled primary and secondary kernels, immersed in 0.04 percent paradichlorobenzene solution for 3 minutes, germinated 78 percent and 57 percent, respectively. Pricking was not necessary.

Fourth treatment: Hulled primary and secondary kernels, alternately frozen at 10°F for 1/2 hour and heated at 110°F for 1/2 hour for a period of 8 hours, germinated 69 percent and 0.0 percent, respectively. Dehulled primary and secondary kernels germinated 17 percent and 19 percent, respectively.

The results from these and other less reliable treatments, both chemical and physical show that the secondary kernel has a higher degree of dormancy than the primary kernel. Also, secondary kernels respond less to chemical and physical treatments than do primary kernels. This is especially true of physical treatments. Regardless of stage of development of the kernel (primary and secondary) and position of kernel on panicle, all kernels exhibited dormancy.

The Oat Stem Rust Resistance Program in Colombia--History and Current Status by Elkin Bustamante, J. Artie Browning, Juan Orjuela, H. David Thurston, Reinaldo Reyes, C. F. Krull, and Hernan Ramirez, Instituto Colombia Agropecuario and Iowa State University -

The situation of the oat improvement program in Colombia has evolved during the last few years from a critical point in 1960, when tests indicated that all available germ plasm, including that in the U.S.D.A. world oat collection, was susceptible to the local races of oat stem rust, to an advanced period in which as a result of greenhouse and field experiments showing the existence of adequate resistance, a crossing program was reinitiated to develop improved, disease resistant varieties.

Initial oat stem rust race identification studies established a large number of races and subraces, including the subrace 6C, which apparently was the most virulent subrace in the world. Prevalent races, including 6C, produced a susceptible type $3^{\pm}$ reaction on D lines in the greenhouse, and a "partially resistant" small pustule reaction in the field. Both are atypical of the reactions of D lines in North America. Thirty-one of 35 subraces identified at Tibaitata produce the type $3^{\pm}$ reaction on D lines. Two are avirulent on Minrus. Only one biotype of subrace 7E and one subrace 3D have complete virulence for Mintrus and produce the typical type 4 pustule.

We recently showed, however, that the D gene in Minrus and other lines loses part of its effectiveness when lines containing it are grown in intense light as happens at the elevation (8,700 feet) of Tibaitata. This affects directly both the race identification and the oat breeding programs. Rust cultures are correctly identified as of subrace 6C in the greenhouse with the naturally intense light of Tibaitata, but they would be identified as of subrace 8A at low light intensities such as those prevailing where races are identified elsewhere. Field inoculations with subrace 8A do not, however, produce the type of reaction normally produced by the North American 8A, and thus light intensity alone does not yet adequately explain the fungus-oat-environment interaction of D lines in the field at Tibaitata. Neither does light intensity alone adequately explain the severe stem rust epiphytotics of 1960-61, as compared to more recent rust virulence and intensity.

The oat variety ICA-Bacata, developed from a cross (Cl-L x Cl/L-R/B) made in 1956, was released in 1965 for commercial production as a forage oat, and thereby became the first oat variety to be released from the program in Colombia. Unfortunately, shortly after Bacata was released subrace 3D appeared. This subrace has complete virulence for Bacata, but the distribution of the race and the degree to which Bacata as a forage oat may be damaged by 3D, are not known.

Relation of Certain Morphological Characters and Root Lodging in Oats[1/] by R. C. Frohberg, North Dakota State University -

The identification of plant characteristics associated with lodging resistance would reduce the breeders' dependence on waiting for an environment which will elicit differential natural lodging and enable him to evaluate lines for lodging resistance at will.

In 1962 and 1963, morphological and anatomical characters of the short internodal portion (the short internodes below ground level) of plants of five hexaploid oat strains and a selection of Avena strigosa Schreb. (C.I. 7010) with known root lodging reaction were studied. Characters measured were: (a) Short-internodes length (b) Elongated-internode, fractional length (c) Top-short internode length (d) Coleoptile node depth (e) Lower short-internodes length (f) Adventitious roots, top node (g) Total adventitious roots (h) Node number (i) Internode diameter/top-short-internode length (k) Culm wall thickness (l) Pith cavity diameter (m) Cross-sectional area of internode tissue (n) Cortex width (o) Sclerenchyma width (p) Cell layers in the schlerenchyma (q) Cortex width/sclerenchyma width.

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[1/] Research conducted at Iowa State University.

In this study, the top internode of the short internodes of the lodging resistant strains had a consistently and significantly wider hypodermal sclerenchyma and greater number of cell layers in the hypodermal sclerenchyma than did the lodging susceptible strains. This internode of the lodging resistant strains also had a greater diameter and a larger cross-sectional area of tissue than the lodging susceptible strains.

Phenotypic and genetic correlations among the plant characters were calculated. Heritabilities on a plant basis were low for most characters; however, the anatomical characters were affected least by the environment.

Evidence of actual breakage of the short internodes was less frequent in the artificially than in the naturally root-lodged oat plants. Almost 50 percent of naturally root-lodged plants examined had broken short internodes. The break in the top internode of the short internodes was usually in the middle one-third of the internode.

Differentiation of Three Barley Yellow Dwarf Virus Strains by Host Reaction by H. Jedlinski and C. M. Brown, USDA and University of Illinois -

In 1962 and 1963 field studies at Urbana, Illinois, a number of differences were noted between three barley yellow dwarf virus (BYDV) strains (Champaign 6, Southern Illinois 1 transmitted nonselectively by Rhopalosiphum padi (L.) and New York MGV transmitted specifically by Macrosiphum avenae (Fabricius) ) on oat selections chosen specifically for their reaction to BYDV and their divergent genetical background. The overall virulence of the Champaign 6, Southern Illinois 1, and New York MGV strains on most of the selections tested was moderate, intermediate, and mild, respectively. Generally, the symptoms of infection with the Southern Illinois 1 virus strain were more severe in the acute stage than those of the Champaign 6 strain. There was much more recovery in the case of the Southern Illinois 1 strain than Champaign 6. In contrast to the above two strains, the New York strain induced very mild but distinct symptoms in the early stage of the disease and almost symptomless recovery later. Several of the oat selections exhibited a very pronounced differential interrelationship between virus strains and host varieties. For example, C.I. 5068 and C.I. 7969 were relatively resistant to the Champaign 6 strain, but susceptible to the Southern Illinois 1 strain. On the contrary, the selections C.I. 1915 and Kanota were relatively susceptible to the Champaign 6 strain but resistant to the Southern Illinois 1 strain. In further field studies in 1964, evidence was obtained for cross-protection, thus indicating a strong possibility that in spite of the observed variety x BYDV strain interactions and other differences the three strains are closely related.

The findings contribute further to our understanding of the basic nature of the BYDV variability and to the virus-strain relationship. They also partially explain why losses due to BYDV have been consistently higher in the North Central Region than in the North East, where M. avenae is the most important vector and apparently the mild strain is the most prevalent strain of the virus.

Variation Within Aphid Species in the Transmission of Barley Yellow Dwarf Virus by W. F. Rochow, USDA and Cornell University -

In addition to variation among different aphid species, variation within one species can be a major factor in virus-vector studies. In some recent tests, no differences in ability to transmit several strains of barley yellow dwarf virus were found when New York clones of Macrosiphum avenae, Schizaphis graminum, and Rhopalosiphum maidis were compared with clones of the corresponding aphid species supplied from Kansas by R. H. Painter or W. H. Sill, Jr. A clone of R. padi from Kansas, however, regularly transmitted one strain of barley yellow dwarf virus that was rarely transmitted in parallel tests by the New York clone of R. padi. In one series of tests, for example, (involving 10 aphids per test plant), the Kansas clone transmitted virus in each of 19 tests (to 44 of 59 total plants); the New York clone of R. padi transmitted virus in 5 of the 19 tests (to 6 of 59 plants). Temperature appeared to be an important factor influencing virus transmission by the 2 clones. In preliminary trials, differences in the ability of the 2 clones to transmit the virus were greater in tests carried out at 70°F than in tests done at 85°F. Differences between the 2 clones of R. padi in the transmission of several other strains of barley yellow dwarf virus were slight or inconsistent. Dr. V. F. Eastop (British Museum of Natural History, London) found a morphological abnormality in wing venation of the Kansas clone of R. padi.

Specific Transmission of an Oat Striate-type and of Wheat Striate Mosaic Viruses by H. Jedlinski, USDA and University of Illinois -

A disease of oats, characterized at first by striations extending parallel to the veins and later with a general mosaic-like mottle and dwarfing, was observed in Illinois at a few locations during the past several years. The virus was recovered by the leafhopper, Graminella nigrifrons (Frobes). It was noted in further studies that Endria inimica (Say.) collected from the Champaign, Illinois area, readily transmitted the South Dakota wheat striate mosaic virus obtained from Dr. G. B. Orlob but did not transmit the virus of similar type from Illinois. Over twenty transmission experiments carried out during the past two years yielded the same results. These results exclude the possibility that the Illinois collection of E. inimica was a biotype unable to transmit the South Dakota virus and differentiate the Illinois virus from the South Dakota one. Attempts are in progress to characterize the Illinois virus isolate further.

Responses of Winter Oat Varieties to Fall vs. Spring Inoculations with Barley Yellow Dwarf Virus by Paul G. Rothman, USDA and Mississippi Delta Branch Experiment Station -

A collection of 34 commercially grown winter oat varieties from the Southeastern States were evaluated in a controlled inoculation study with a single strain of BYDV. Hill plots of the varieties were both infested in the fall and in the spring with viruliferous apple-grain aphids previously fed on a moderate strain of BYDV. Following a 1-week inoculation feeding period, the apids were destroyed with malathion spray. Similar plots not infested with apids were maintained as checks.

Differences in responses between both the fall and spring inoculated hill plots with the control hill plots were measured.

Grain yields were reduced 86% with fall inoculation vs. 39% with spring inoculation over the check plots. Plant height was reduced 40% vs. 15%; tillering 58% vs. 18%; plant weight 82% vs. 40%; and weight per 100 primary kernels 26% vs. 0%, respectively.

Studies on the Septoria disease of Oats by R. V. Clark, Canada Department of Agriculture, Ottawa -

The septoria disease caused by the fungus *S. avenae* f.sp. *avenae* is prevalent in all oat growing areas of Eastern Canada and in some parts of Western Canada. Most years the disease is initiated early in the season resulting in serious losses in yield. The principle aim of the research being carried out on this disease is the development of resistant varieties. Oat varieties, introductions, hybrids and wild species have been screened and wild species and interspecific hybrids showed the highest resistance. Several commercial varieties exhibit various levels of resistance and six of the best of these have been intercrossed to combine their resistance genes in one hybrid.

Investigations have been carried out on several aspects of this disease. Host plant nutrition influenced septoria development to a considerable extent. Disease development increased when the concentration of balanced nutrients were decreased and when low amounts of potassium or high concentrations of phosphorus were supplied. Low concentrations of nitrogen and high concentrations of potassium decreased disease development slightly. The perfect state of the fungus (*Leptosphaeria avenaria* f.sp. *avenaria*) is being studied to learn more about the variability of the causal organism. Various techniques have been employed in an effort to produce the perfect state under artificial conditions. An isolate of the fungus was found that produced macrospores in culture that were morphologically similar to ascospores.

Influence of leaf age and light on the symptomology of oat halo blight by R. D. Durbin, USDA and University of Wisconsin -

The characteristic symptoms of halo blight, as first described by Elliott, are chlorotic, oval spots surrounding small areas of collapsed gray-brown tissue. The expression of these symptoms are, however, markedly dependent upon the age of the leaf when inoculated and light intensity during incubation.

Leaf tissue up to about 10 days old, when inoculated, showed typical symptoms. Beyond this, the older the leaf, the more necrosis there was in place of the chlorosis. Light is necessary for symptom expression. Low light intensities delayed symptom development; leaves kept in the dark never showed symptoms, but they developed symptoms in a normal manner when returned to high light intensity. These two factors suggest that field infection of older, basal oat leaves by *Pseudomonas coronifaciens* may result in an atypical symptom expression.

## Friday afternoon - Feb. 11

Mass Selection Experiments in Oat Populations by G. Romero, R. Reyes, D. Tiyawalee and K. Frey, Iowa State University -

A genetically heterogeneous oat population was created in 1957 by mixing remnant seed from 250 oat crosses (10 gms per cross). A very wide range of germ plasm was included into the "composite" population, but each cross included had one adapted parent. The composite was divided into a number of samples which were used to test the effectiveness of various mass-selection techniques when applied over several generations. A remnant sample of seed from each generation was retained in cold storage. Mean population size for each technique-generation combination was 70,000 plants.

After 4 to 7 consecutive cycles of selection using one technique, lines from all generations of the selected and check (no selection applied) populations were assayed for the selected and other agronomic attributes. The number of lines tested in each "generation - line of descent" combination varied from 45 to 75. Hill-plot experiments conducted in randomized-block arrangements with 3 to 6 replications were used.

Here, I will summarize the data upon 4 mass-selection techniques -- plant height, seeding density, crown rust epiphytotic and seed width.

For plant height selection, we clipped all oat culms in a plot to a uniform height (determined by check variety height). At maturity the top 4 inches of the clipped culms were harvested, threshed en masse, and used to propagate the succeeding generation. When averaged over 4 cycles of selection this technique reduced plant height 0.7 inches and maturity by 0.5 day and increased yield by 1.6 bu. per A., per generation.

Three planting rates - 1, 3 and 5 bu. per A. were used for 5 consecutive generations on another set of samples. The several planting rates failed to differentiate population means for any of 5 attributes measured - number of panicles per hill, number of spikelets per panicle, grain yield, plant height and heading date.

For seed-width selection, the lot of seed was put over a screen with slots of size 6/64 x 1/2, and only that seed which remained on top of the screen was used for propagating the next generation. When averaged over 5 cycles the mean seed weight of the selected population was increased 0.1 gm per 100 seeds per generation. The selected populations also became taller and later by 0.65 inches and 1.0 day, respectively, per generation. However, within the selected and unselected populations the genetic correlations between heading date and seed weight were negative.

To increase the frequency of crown rust resistant plants, the oat population was subjected to 7 cycles of artificially induced epiphytotics. The seed after harvest was threshed and winnowed to eliminate light-weight seeds. The percentage of resistant plants in the population was increased approximately 3 percent per cycle.

Our experiments show that mass selection can be a potent tool for increasing the proportion of desirable genotypes in a genetically heterogeneous oat population. Mass selection will be most effective if: (a) subjective selection techniques are used; (b) population size is maintained large in each generation of selection; (c) heritability (either natural or manipulated) of the character under selection is high; (d) a combination of techniques is used simultaneously to counteract correlated response to selection by one technique.

Breeding for Increased Winter Survival in Oats by Verne C. Finkner, University of Kentucky -

Since 1960 the Kentucky Agricultural Experiment Station has concentrated its small grain program on the problem of breeding for increased winter survival in oats. If winter oats are to be a reliable crop in the Ohio Valley and similar climatic areas, adapted varieties must be developed that provide winter survival characteristics as good as or better than the hardiest varieties now known. The problem is one of developing an effective selection system for the complicated characteristic of winter survival.

Evaluations of the breeding systems (1) bulk hybrid, (2) pedigree, (3) modified bulk hybrid and (4) backcrossing have been conducted. Data obtained showed the bulk hybrid method to be ineffective in isolating lines with superior winter survival. Data on pedigree breeding showed the following relative values of previous data in predicting $F_5$ survival performance: $F_4$ family > $F_4$ source line > averaged $F_3$ and $F_4$ source line > $F_3$ source line > highest surviving $F_4$ source lines from highest surviving $F_3$ source lines.

The modified bulk hybrid system was bulk progeny tests of individual $F_2$ plants in the $F_3$ and $F_4$. The data showed that $F_3$, $F_4$ or averaged $F_3$ and $F_4$ source row survivals were not useful in predicting derived $F_5$ line survivals.

Winter survival characteristics can be transferred by backcrossing but desirable combinations of winter survival and other characteristics were more quickly obtained from segregates of the first cross. In a LeConte x Dubois cross, three backcrosses to LeConte were made. Progenies selected from the original cross and from each backcross had combined winter survival and straw strength greater than that of the better parent for each characteristic.

Transgressive segregation for winter survival has been found in most crosses that we have studied in detail. Again the problem is one of developing an effective selection system for early recognition of transgressive segregates.

<u>Contribution by Headed and Non-Headed Tillers to Grain Yield of Spring Oat Plants by Verne C. Finkner and Ronnie Coffman, University of Kentucky</u> -

Contribution by headed and non-headed tillers to grain yield was measured in a greenhouse experiment using the spring oat variety Brave. Two pot sizes (4" and 6" width) with one to eight plants per pot were used to obtain differential tiller numbers. Another treatment of continual tiller removal was imposed on each pot size with one to four plants per pot. Yield and yield components were measured on a per culm basis.

Grain yield <u>per pot</u> reached a maximum at four plants per pot and leveled off. Differences in grain yield were primarily due to seed numbers and not individual seed weight.

Grain yield <u>per plant</u> was reduced as number of plants per pot was increased.

Grain yield per <u>primary culm</u> was higher when the non-headed tiller number was higher where tillers were or were not removed. Tiller number therefore was dependent upon the vigor of the primary culm and not vice-versa. Grain yield comparisons per <u>primary culm</u> where equal number of tillers were removed or left were not valid since tiller removal stimulated other tillers to develop. Grain yield per <u>primary culm</u> was increased by removing tillers at low population per pot but decreased at higher populations per pot.

Grain yield per primary culm was higher on a plant with a headed tiller than on a plant without a headed tiller when both were present in the same pot. At the same population level, the highest yielding primary culms with a headed tiller were equal in yield to the highest yielding culms with tillers removed.

Grain yield on the primary culm was higher than that of the first tiller. Grain yield of the first tiller was higher than that of the second tiller, etc.

Headed tillers compensated for below optimum plant population only when plant population was slightly below optimum.

Use of Controlled Freezing Tests in Winter Oat Improvement by H. G. Marshall, USDA and Pennsylvania State University -

Although the expression of winter hardiness in oats is affected by many factors, resistance to low temperature is the major component involved. Cold resistance can be accurately determined with freezing techniques which either control or eliminate variables that may alter either its expression or the measurement thereof (or both). Accurate cold resistance data can be used to predict winter hardiness within a relatively narrow survival range, and are of value in both the basic and applied phases of oat improvement for winter hardiness.

Results from freezing experiments have demonstrated that a maximum expression of cold resistance facilitated varietal differentiation for that characteristic, and this was dependent on a satisfactory hardening treatment. The expression of cold resistance during this phase was modified by nutrition (levels of N, P, and K), light intensity, temperature, and treatment duration. Seed source was an important factor in experiments with young plants and caused within variety survival differentials of up to 45% at 12 days of age. This effect was not important at 26 days of age or thereafter. The stage of plant development most favorable for the maximum expression of cold resistance occurred at 33 days of age.

Accurate measurement of the cold resistance developed was primarily dependent upon uniform temperature stress during the freezing treatment. This was a major problem in experiments with plants in flats of soil or sand, and differences in soil temperature of 3 to 4° F. were common at the end of a freeze treatment. In general, only varieties known to differ greatly for winter hardiness were differentiated with certainty for cold resistance. A technique of freezing plant crowns in moisture proof paper bags was subsequently developed to avoid these soil temperature gradients, and cold resistance was based on survival as determined by regrowth from the crowns. Excellent differentiation of varieties for cold resistance was obtained and experimental error was low. The most satisfactory results were obtained with crowns from plants grown and hardened in the field.

Helminthosporium Victoriae and Oats: Bases for Host-Selectivity and Host Resistance by R. P. Scheffer, Michigan State University -

Host selectivity is governed by one toxic determinant produced by the fungus. This and the fact that host resistance is based on lack of sensitivity to the compound have been confirmed many times, but the mechanisms of toxin resistance has been controversial. Much circumstantial evidence indicates that susceptible plants have a toxin receptor or sensitive component that is lacking or protected in the resistant plant. The kinetics of toxin uptake, competitive inhibition between toxin and certain of its breakdown products, and the independence of toxin uptake and active metabolism all point to this interpretation, as do negative data on other reasonable hypotheses. Physiological changes in infected tissue that are reproduced by the toxin will be summarized. Early histological response of tissue to invasion by H. victoriae is typical of many plant infections.

Other host-selective determinants have been found. One is produced by H. carbonum which is sexually compatable with H. victoriae. Progeny of this cross segregated 1 : 1 : 1 : 1 for oat toxin, corn toxin, both toxins, and no toxin. Pathogenicities were correlated with toxin producing potentials.

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## II. SPECIAL REPORTS

### Proposal for a Uniform System of Numbering Varieties and Selection and of Recording Hybrid Parentages for Use with Data Processing Machines[1]

by C. F. Konzak -- Washington State University

The use of data processing machines in plant breeding programmes can result in increased accuracy and efficiency, and provide ready access to a whole store of available information about any given variety or selection. Machines using a punch card system appear to offer the greatest flexibility for the many purposes that might be involved.

Various systems designed for uniform reporting and machine processing of cereal research are already being used by plant breeders and other cooperating scientists. One general type of system is designed cooperatively by scientists at Washington and Montana State Universities.

Components of this data recording and processing system include series of Variety Records, Experiment and Data Records. Data are first recorded in machine-printed field record books and then punched directly from them into the data cards. The machine printing can also provide lists, labels for field stakes and harvest bags, etc. and many other services at low cost and great labor efficiency.

However, for an effective and systemized data recording and processing system an accurate and permanent record of information about each variety or selection is required. The selections must be identifiable according to a uniform system of naming and numbering. The following is offered as a basis for a uniform system of records:

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[1] This research was supported in part by grants from the Washington State Department of Agriculture and the Washington State Wheat Commission.

## I. Selection or Variety Number

We propose that a permanent identification number be assigned to selections or cultivars by research institutes, record centers (for state accessions) or responsible national or international agencies. That is, spring wheat research leaders should assign the numbers to selections of spring wheats, barley research leaders to barley, etc. A system using a two-letter code followed by six numbers appears to satisfy the requirements for identifying selections according to a uniform pattern. This system alone would identify a million accessions in 676 major series. Thus, eight spaces must be allotted for the variety number on each punch card and on each Variety Record of data recording and processing systems.

A. Accession series identification: The first two spaces for variety numbers have been allotted for distinguishing the accession series (code). We suggest that the letters UN be reserved for future FAO accession numbers.*

1. U.S. State Accession Systems: State accessions in the United States might carry the two letter codes used in the Zip Code system of the U.S. Postal Service for state abbreviations. As an example, the letters WA have been assigned to the Washington State general accession series and will designate Washington selections from those of other states. These standard codes will eliminate confusion between the various systems of accession and selection numbers.

A copy of the codes assigned to the 50 U.S. States and U. S. Territories by the U.S. Postal Service is attached.

2. Local Accession Systems: Each plant breeder at each experiment station should assign his own accession numbers according to a compatible system. Local accession series can be distinguished from others if a single letter code is used. The local accession codes below assigned to Washington State plant breeders illustrate the principle suggested.

Local Accession Codes Used at Washington State University

| Worker | Crop | Accession Code |
|---|---|---|
| Vogel-Peterson | (wheat) | V |
| Allan | (wheat) | A |
| Nelson-Nagamitsu | (wheat) | N |
| Konzak-Csiba | (wheat) | K |
| Nilan-Muir | (barley) | E |
| Konzak-Bacon | (oats) | O |
| Konzak-Dickey | (wheat and durum mutants) | |
| or Nilan-Muir | (barley mutants) | X |
| Konzak-Bacon | (durum) | D |

* It should be noted that after this proposal was prepared, a more international approach to the designation of national accession codes was recommended by a group of scientists called to advise the FAO and IAEA on their and related subjects (see report of this consultant group). These recommendations may affect some of the suggested U.S. State codes, because national accession series should retain priority.

Stations with only one breeder for a given crop plant might simply assign the letter B for barley, W for wheat, etc., much as was done in Missouri for oats, i.e., 0205, though in the local system one letter followed by seven numbers completes the variety accession number.

However, to make the whole system workable, a hierarchy of accession systems must be recognized. Local accession series should be used only locally. Since duplication of code systems at the local level might occur between states, interstate sharing of selections by breeders would require that the selections carry state accession numbers. State, national or international (probably UN) accession numbers should be used (in that order) whenever they have been assigned. In the U.S., C.I. numbers should be considered a higher order than P.I. numbers.* Allowance in the variety record system has been made to permit cross reference to previous accession numbers assigned to a variety.

B. Completing the Variety or Selection Number: For the national and state accessions the six columns after the accession series code must be numerical. These six numbers plus the accession code make up the complete variety number. Local accessions may have seven digits following the code letter identification. These numbers should be assigned to a variety or selection and considered permanent until a higher order accession number is assigned. In the case of local or early general selections, the year of the accession might be used as part of the line or the number indicated after the accession series code. This could be followed by the experiment number and the cross number, thereby completing the variety number.

1. Example of a local variety or selection number: A local breeder's selection might be as follows: V6416595. The first three symbols V64 indicate the accession series as V or Vogel (see code in A2, local accessions)and the date of accession as 1964. The next five numbers could show that it was row, selection or cross number 595 for Experiment No. 16 in 1964. It should be noted that this number, together with the parentage section (see II.) completely identifies early generation selections. However, the numbering system could vary somewhat for each individual research leader to best suit his needs. For example, some workers might number their $F_1$'s as V641 and V642 for crosses one and two accessioned in 1964.

In any case, it should be the responsibility of each research leader to make certain that the system he desires to use is compatible with the recommended uniform code system.

C. Numbering of Introductions: Local and state accession numbers could also be applied to introduced selections carrying numbers that do not conform to the system. Hopefully, general acceptance of an internationally recommended system and consequent local revisions might in part reduce this problem, since it will clearly result in some unavoidable duplication. The origin and source of these selections and the pedigree records can be included in a variety identification record to prevent the loss of identity that might otherwise occur, and to permit the cross reference and easy revision, should changes be warranted. A format for recording variety identification will be recommended by the responsible international group.

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*It may be desirable to eliminate or change such codes as the P.I. and C.I. codes because under the suggested system they may be replaced by a U.S. code.

D. Previous Variety Numbers: The previous local accession series and number assigned should also be given, in case a change is made in the variety number and accession series. This number should be included in the variety identification record to facilitate the tracing of the testing history on varieties moved to advanced tests, as for example, those entered in regional nurseries and given State and C.I. numbers.

## II. Variety Name

### Suggested Uniform Allotment of Space for Variety Names and Parentages

Thirty-two spaces (letters, numbers, blanks or symbols) have been recommended in the variety identification records for printing the variety name or the parentage of advanced and early generation selections (see consultant's report.) This number of spaces is a compromise between requirements for economy and requirements for space to identify early generation selections. (In some systems as in Washington and Montana, only 24 spaces will be allotted but space will be made in the record cards to conform with the international system.) Thus, if a variety name or cross listing exceeds 32 or 24 spaces, an abbreviation of the complete variety number should be used instead.

## III. Proposed Uniform System of Recording Hybrid Parentages

While various older systems of writing parentages may sometimes have to be used (as far as possible within the limitations of most data processing machines*), to maintain accuracy in recording histories of old varieties, a standard format for presenting hybrid parentages is desirable. A system as described hereafter is suggested for use with all new selections. This system is essentially that suggested by Wiebe but modified, because most data processing machines will print only in upper case and superscripts cannot be used. Thus, we have adapted Wiebe's system to conform with known machine output capabilities. The proposal by Wiebe is reproduced here along with our adaptations:

1. Wiebe's Proposal: In the 1960 Barley Newsletter Wiebe wrote, "In the course of applied small grain breeding it often happens that numerous varieties are used in the synthesis of a commercial variety. The breeding involved may consist of various combinations of simple crosses, multiple crosses and backcrosses. Common practices of writing such complex crosses are to use parentheses, brackets, quotation marks, braces, etc., to describe the sequence of crosses used. The difficulty encountered in reading such hybrids and of writing them on a typewriter needs no comment. For most routine uses, complex hybrids need not be written out in full, as hybrid numbers or other short-cut devices will usually suffice. On the other hand,

*These limitations are concerned only with the generally available character set which includes 48 uniform characters. These are: letters A to Z, numbers 0 to 9, asterisk*, right parenthesis), left parenthesis(, period., comma,, equal=, slash/, plus+, minus-, quotation mark', blank and dash—. Roman numerals should not be used. To facilitate sorting, variety names or parentages should begin with letters or numbers only, not with parentheses or other characters.

when a complete history or synthesis of the cross is needed, a concise, straightforward method of writing the parental stocks used is highly desirable. It is to meet this latter need that the following proposed suggestions are made. The suitability of the method for use on a typewriter and by the printer has been kept in mind.

### 2. Wiebe's Rules and Our Adaptations for Printing with Data Processing Machines:

1. Wiebe: Crosses are designated by the symbols X, 2X, 3X, etc. and indicate successive crosses in the pedigree of the hybrid. The action carried out for any particular cross in the sequence is described by the numerical value of that cross and any attached superscripts in conformity with rules two and three.

1. Adaptation: Crosses are designated by use of numbers and a slash (/, 2/, 3/, etc.) to indicate successive crosses in the pedigree of the hybrid, The action carried out for any particular cross in the sequence is described by the numerical value of that cross and any additions in conformity with rules two and three. The slash (/) and X have the same meaning. However, when the slash is used, no space between variety names and the cross symbol is necessary for easy reading.

2. Wiebe: The parental material involved in any particular cross (X, 2X, 3X, etc.) includes all that listed on either side of the symbol in question and up to the next higher value of (X).

2. Adaptation: The parental material involved in any particular cross (/, 2/, 3/, etc.) includes all that listed on either side of the slash in question and up to the next higher value of (/).

3. Wiebe: Backcrosses are indicated by the superscript numerals at the (X) symbol and placed on the same side of the symbol as the recurrent parent. The numerals indicate the number of times the recurrent variety or hybrid was used as a parent.

3. Adaptation: Backcrosses are indicated by numerals placed before the name of the recurrent parent. The numerals indicate the number of times the recurrent variety or hybrid was used as a parent. If the recurrent parent is a complex hybrid, parentheses must be used to indicate the limit of the pedigree of that parent. Only in this type of pedigree should the use of the parentheses be necessary. No pedigree should begin with a parenthesis, as this would result in an improper separation by sorting machines.

### 3. Examples of Present System, Wiebe and Our Adaptations

#### Simple

1. Present method --- (Lulu X Tuxedo) X Cicero
2. Proposed method (Wiebe) --- Lulu X Tuxedo 2X Cicero
3. Adapted to data processing machines: LULU/TUXEDO 2/CICERO

#### Complex

1. Present --- (Hero X Hobbs) X (Maggie X Swing) X"Major X (Butler X Cape) X (Corky X Bell)"

2. Proposed (Wiebe) --- Hero X/Hobbs 2X Maggie X Swing 4X Major 3X Butler X Cape 2X Corky X Bell
3. Adapted: HERO/HOBBS 2/MAGGIE/SWING 4/MAJOR 3/BUTLER/CAPE 2/CORKY/BELL

<u>Examples using rules 1, 2, 3</u>

<u>Simple</u>

a) 1. Present --- Polo X $Polk^3$
   2. Proposed (Wiebe) --- Polo $X^3$ Polk
   3. Adapted: POLO/3POLK

b) 3. Adapted: 3TRAILL/GEM

<u>Complex</u>

1. Present --- "(Sky X $Lark^2$) X Rock $^4$X Pole X (Dale X Bibb)" X $Stone^6$
2. Proposed (Wiebe) --- "(Sky $X^2$ Lark 2X Rock $^4$3X Pole 2X Dale X Bibb 4$X^6$ Stone)"
3. Adapted: 4(SKY/2LARK 2/ROCK) 3/POLE 2/DALE/BIBB 4/6STONE

Suggested Method for Designation of Sub-Selections: To preserve space the term selection can be indicated by a dash rather than by the abbreviation SEL or S before the selection number. The line or sub-selection number should be recorded as part of the variety name, NOT the variety number. A new variety number should be applied to the new selection, retaining the parentage record.

TWO-LETTER STATE ABBREVIATIONS*

| | | | | | |
|---|---|---|---|---|---|
| Alaska | AK | Kentucky | KY | Ohio | OH |
| Alabama | AL | Louisiana | LA | Oklahoma | OK |
| Arizona | AZ | Maine | ME | Oregon | OR |
| Arkansas | AR | Maryland | MD | Pennsylvania | PA |
| California | CA | Massachusetts | MA | Puerto Rico | PR |
| Canal Zone | CZ | Michigan | MI | Rhode Island | RI |
| Colorado | CO | Minnesota | MN | South Carolina | SC |
| Connecticut | CT | Mississippi | MS | South Dakota | SD |
| Delaware | DE | Missouri | MO | Tennessee | TN |
| District of Colombia | DC | Montana | MT | Texas | TX |
| Florida | FL | Nebraska | NB | Utah | UT |
| Georgia | GA | Nevada | NV | Vermont | VT |
| Hawaii | HI | New Hampshire | NH | Virginia | VA |
| Idaho | ID | New Jersey | NJ | Virgin Islands | VI |
| Illinois | IL | New Mexico | NM | Washington | WA |
| Indiana | IN | New York | NY | West Virginia | WV |
| Iowa | IA | North Carolina | NC | Wisconsin | WI |
| Kansas | KS | North Dakota | ND | Wyoming | WY |

*Codes assigned by U.S. Post Office.

# Rules for Abbreviating Wheat Variety Names with Proposed Adaptations for Computer Processing[1/]

by C. F. Konzak

A useful system of rules for abbreviating variety names was developed by L. P. Reitz and L. W. Briggle, and published by National Wheat Improvement Committee in USDA Tech. Bulletin 1278. This system, reported also in Agronomy Journal 52: 613, 1960, has received rather wide acceptance. However, certain features of the system must be adapted for use with automatic data processing machines which are destined to play a vital role in the sorting and processing of information from crop plant research. These changes are few and dictated primarily by the limited standard character set of the data processing machines.

Most of the machines now available have the following character set, which includes 48 uniform characters: Letters A to Z, numbers 0 to 9, asterisk *, right parenthesis ), left parenthesis (, period ., comma ,, equal =, slash /, plus +, minus -, quotation mark ', blank and dash --. Roman numerals should not be used.

The procedure for abbreviating is based on major and minor syllabic divisions of varietal names. Names with lower C.I. numbers are given precedence in the case of duplicate abbreviations. A third letter from the name with the higher C.I. number is added to the abbreviation to circumvent duplication.

Periods are not used following abbreviations. Three- and four-letter names (Oro, Burt) should be written in full, and at this time are not listed with the variety name abbreviations.

Rules for abbreviating variety names, with examples, and changes from the system of Reitz and Briggle, presented in bold type, are:

a. Use the first letter of the name and the first consonant of the second syllable (Ashkof = AK) - all in upper case letters.

1. If there is duplication, add the next appearing consonant in the second or higher order syllable (Chancellor, C.I. 12333 = CC; Cascade, C.I. 12376 = CCD; Concho, C.I. 12517 = CCH). Note that lower C.I. numbers are given precedence.

2. When all consonants in the second or higher order syllable appear in duplicate abbreviations, use the first letter of the name, the final consonant of the first syllable, and the already used consonant of the second syllable (Honor = HNR, HR having been assigned to Huron).

3. If duplication still exists, use the final vowel of the name as the third letter of the abbreviation (Montana = MTA).

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[1/] This research was supported in part by grants from the Washington State Department of Agriculture and the Washington State Wheat Commission.

b. When the second syllable is composed of a vowel only, the vowel is used with the first letter of the name (Wichita = WI).

1. If there is duplication, add the first (or succeeding) consonant(s) in the third syllable (Ariette, C.I. 6243 = AI; Alicel, C.I. 11700 = AIC).

2. If there are no consonants in the second or higher order syllables, use the vowels in order of appearance, along with the first letter of the name. (Bowie = BI; in case of duplication, Bowie would be BIE).

c. In the case of one-syllable names, the final consonant is used with the first letter (Baart = BT). Reitz (pers. Comm.) later suggested no abbreviation of 5-letter words.

1. If there is duplication, the consonant preceding the final one is added (Baart would then be BRT).

d. When a name is compound, abbreviate each word (American Banner = A.B) <u>but place a period between</u>.

1. When abbreviations of compound names are duplicated, add the first consonant of the second word to one name (Red Russian = R.R.; Red Rock = R.RC)

e. A varietal name followed by a number is abbreviated according to the above rules. The number is written with a blank space after the abbreviation (Atlas 66 = ATL 66). If the number is designated as a selection number, use as S before the number.

f. The first letters of generic and specific names are used (<u>Aegilops umbellulata</u> = A*UM), <u>but place an asterisk between the letters</u>.

g. When two names are nearly identical, use the first distinguishing letter as the third letter of the abbreviation (Supreme = SPE; Supremo = SPO).

We propose further that lists of abbreviations be prepared as an aid to workers wishing to use standard abbreviations in their work.

EXAMPLE: WHEAT VARIETY NAME ABBREVIATIONS

| | Reitz & Briggle Abbrev. | Proposed Modification | C.I. No. | P.I. No. |
|---|---|---|---|---|
| 1. <u>Aegilops umbellulata</u> | <u>Au</u> | A*UM | | |
| 2. <u>Agropyron elongatum</u> | <u>Ae</u> | A*EL | | |
| 3. Agrus | Ars | ARS | 13228 | |
| 4. Akrona | Ar | AR | 6881 | |
| 5. Alaska | Als | ALS | 5998 | |
| 6. Albit | Ab | AB | 8275 | |
| 7. Alicel | Aic | AIC | 11700 | |
| 8. Allen | Al | AL | 5407 | |
| 9. Alstroum (Spelt) | As | AS | 1773 | |
| 10. Alton | At | AT | 1438 | |
| 11. American Banner | AB | A.B | 6943 | |
| 12. Anderson | Ad | AD | 12536 | |
| 13. Anniversario | Aiv | AIV | | |
| 14. Apache | Ap | AP | 12122 | |
| 15. Arcadian (Early) | Ac | AC | 5536 | |

| | | | |
|---|---|---|---|
| 16. Ariette | Ai | AI | 6243 |
| 17. Arnautka | An | AN | 1494 |
| 18. Ashkof | Ak | AK | 6680 |
| 19. Ashland | Aln | ALN | 6692 |
| 20. Athena | Ath | ATH | 11693 |
| 21. Atlas 50 | Atl 50 | ATL 50 | 12534 |
| 22. Atlas 66 | Atl 66 | ATL 66 | 12561 |
| 23. Austin | Atn | ATN | 12346 |
| 24. Avoca | Av | AV | 13395 |
| 25. Awned Onas | AO | A.O | 12235 |
| 26. Axminster | Am | AM | 8195 |
| 27. Aztec | Atc | ATC | 13016 |
| 28. Baart | Bt | BT | 1697 |
| 29. Baart 38 | Bt 38 | BT 38 | 11907 |
| 30. Baart 46 | Bt 46 | BT 46 | 12386 |
| 31. Bacska | Bs | BS | 1562 & 6156 |
| 32. Baldreck | Br | BR | 11538 |
| 33. Barnatka | Bn | BN | 8214 |
| 34. Bearded Winter Fife | BWF | B.W.F. | 493, 1942 & 6401 |
| 35. Beloglina | Bo | BO | 1667 |
| 36. Berkeley Rock | BR | B.R | 8272 |
| 37. Big Club | BC | B.C | 4257 |
| 38. Big Club 37 | BC 37 | B.C 37 | 11901 |
| 39. Big Club 43 | BC 43 | B.C 43 | 12244 |
| 40. Big Frame | BF | B.F | 6184 |
| 41. Bison | Bsn | BSN | 12518 |
| 42. Blackhawk | Bhk | BHK | 12218 |
| 43. Blackhull | Bh | BH | 6251 |
| 44. Black Winter | BW | B.W | 3042, 3665 & 3682 |
| 45. Bledsoe | Bds | BDS | 13238 |
| 46. Bluechaff | Bc | BC | 5256 |
| 47. Blue Jacket | BJ | B.J | 12502 |
| 48. Bobin | Bbn | BBN | 11194 |
| 49. Bowie | Bi | BI | 13146 |
| 50. Brevit | Bv | BV | 3778 |

## Puerto Rico Oat Rust Nurseries

by H. C. Murphy, J. D. Miller, and J. C. Craddock, USDA

J. D. Miller has replaced D. V. McVey at Mayaguez, with responsibility for the Puerto Rico phase of the cereal rust nurseries. McVey has joined the staff of the Cooperative Rust Laboratory at St. Paul, Minnesota. The overall wheat and oat rust-testing program in Puerto Rico is coordinated by L. P. Reitz, Crops Research Division, Beltsville, Maryland. The oat rust nurseries are coordinated by H. C. Murphy. All seed is assembled and data distributed by J. C. Craddock at Beltsville.

Although Thomas Theis, D. V. McVey and J. D. Miller have had successive primary responsibility for the cereal rust nurseries in Puerto Rico, credit is due the many cooperators who have assisted in making the readings during past years, and to Felix A. Jimenez, Agricultural Aid, Federal Experiment

Station, Mayaguez. A partial list of those who have assisted in making the oat rust readings since the current Puerto Rico program was initiated is as follows:

| Year | In charge | Assisted with readings |
|---|---|---|
| 1958 | T. Theis | H. C. Murphy |
| 1959 | T. Theis | K. J. Frey, L. P. Reitz, M. D. Simons, D. E. Western |
| 1960 | T. Theis | H. C. Murphy, H. L. Shands, L. A. Tatum |
| 1961 | D. V. McVey | W. H. Chapman, F. A. Coffman, H. H. Luke |
| 1962 | D. V. McVey | J. A. Browning, R. M. Caldwell, J. P. Meiners |
| 1963 | D. V. McVey | G. J. Green, L. P. Reitz, B. J. Roberts, R. W. Romig |
| 1964 | D. V. McVey | E. Bustamante, G. Fleischmann, M. F. Kernkamp, J. F. Schafer |
| 1965 | D. V. McVey | I. M. Atkins, J. D. Miller, H. C. Murphy |
| 1966 | J. D. Miller | I. M. Atkins, R. M. Caldwell, H. C. Murphy, F. J. Zillinsky (tentative) |

Entries for the Puerto Rico oat rust nurseries are accepted from research institutions throughout North America when parentage indicate a source of resistance to the specific rust races being used. The number of entries accepted from any one institution may be limited depending upon the space available. We anticipate that an appreciable amount of space will be needed during the next few years for testing rather extensive and recent USDA and Canada-Wales wild oat species collections.

The locations, number of entries, and races of rust for each of the Puerto Rico oat rust nurseries grown in 1965-66 were as follows:

| Location | Race | No. of entries | Rust |
|---|---|---|---|
| Isabela | 6AF | 2,099 | Stem |
| Lajas | 6AFH | 2,060 | Stem |
| Mayaguez | 264 | 3,843 | Crown |

M. D. Simons supplied the inoculum of crown rust race 264 for inoculating the Mayaguez nursery. B. J. Roberts supplied the inoculum of 6AF and 6AFH for the stem rust nurseries at Isabela and Lajas. Supplying adequate, viable, and pure inoculum is a major contribution and vital to the success of the Puerto Rico oat rust nursery program.

The number of United States, Canadian, and Colombian cooperators submitting entries, states or provinces participating, and rows of oat grown in each nursery, for the past five seasons, has been as follows:

| | 1961-62 | 1962-63 | 1963-64 | 1964-65 | 1965-66 |
|---|---|---|---|---|---|
| Cooperators | 21 | 17 | 19 | 11 | 10 |
| States and provinces | 18 | 14 | 18 | 10 | 8 |

| | 1961-62 | 1962-63 | 1963-64 | 1964-65 | 1965-66 |
|---|---|---|---|---|---|
| Approximate no. of rows | | | | | |
| Crown rust race 264 | 4,774 | 3,719 | 4,830 | 2,024 | 3,843 |
| Crown rust race 290 | ----- | 3,552 | ----- | ----- | ----- |
| Crown rust race 321 | 2,964 | ----- | ----- | ----- | ----- |
| Stem rust subrace 6A | 2,238 | ----- | ----- | 1,515 | ----- |
| Stem rust subrace 6A,13A | ----- | 1,398 | 3,025 | ----- | ----- |
| Stem rust subrace 6AF | ----- | 411 | 2,640 | 1,565 | 2,099 |
| Stem rust subrace 6AFH | ----- | ----- | ----- | ----- | 2,060 |
| Total | 9,976 | 9,080 | 10,495 | 5,104 | 9,002 |

## Methods of Testing Small Grains at Tipton, Georgia

by D. D. Morey

Methods of testing small grains at the Coastal Plain Experiment Station, Tifton, Georgia have changed considerably during the past 10 years. Part of the change has been brought about as necessary mechanization and part as a process of learning. In hopes that a comparison of programs might be useful, the Tifton field tactics are outlined here.

Crops --- Rye, 40%; Oats, 30%; Wheat, 20%; and Barley, 10%. The percentages show the approximate emphasis given to each crop. All are fall-sown.

Crop Rotation --- Small grains usually follow cotton, A summer crop of cow-peas are planted on cotton land allowing about 1 year for cotton stalks to decompose before small grains follow cotton.

Liming --- 1 ton of dolomitic limestone is applied before small grain planting about every third or fourth year. A pH of about 5.6 is desirable but small grains seem to tolerate fairly wide deviations of soil pH.

Fertilization --- We are glad to see broadcast application of fertilizer for all crops of corn, cotton and peanuts which precede small grains. For a number of years the small grain nursery followed directly behind cotton which had been fertilized in the row. Planting was difficult and variability was extremely high because of row fertilizer placement.

The small grain nursery area now receives 500 pounds per acre of 5-10-15 fertilizer before plowing or turning the land. This is broadcast by an 8 ft. Gandy spreader pulled by a Ford or Ferguson tractor. By using a legume cover crop it is usually not necessary to top-dress the nursery with additional nitrogen.

Land Preparation --- In August green cowpeas are cut into the soil by disking several times. They are allowed to decompose a month or more before plowing.

We have found tractor wheel compaction to be one of the causes for high variability in small grain yield trials. Consequently, from plowing time on to maturity, no tractor wheel is allowed inside a grain yield plot. This is accomplished by use of the "bedding" method and by special plowing. In the past it was customary to plow (turn) small grain land and disk or harrow it several times. This method left hidden tractor wheel depressions in great confusion all over the field. We now do all liming, fertilizing and disking of cover crops before we plow. A 3-bottom plow has now been equipped with trash-covering coulters and rake teeth for breaking clods and leveling land. After plowing, the land is "laid-off" in beds with a 4-wheel tractor with wide front axle set on 64 inch wheel widths. All subsequent operations are done in the same wheel tracks so there is no wheel compaction within the 4-row plots.

Insect Control --- As soon as the nursery field has been "laid-off" in long beds we spray with dieldrin (2#/A.) with tractor equipment. This controls wireworms, mole-crickets and especially less cornstalk borers which tend to build up in the cover crops. The beds can also be cultivated before planting to incorporate insecticides and to kill young weed growth.

Planting --- Planting is done with a cone-type, tractor mounted, 4 row nursery planter. The planter was built by J. G. Futral at Experiment, Georgia. Nursery rows are 12 inches wide and 12 feet long. Early November is the usual planting time at Tifton.

Irrigation --- If soil conditions are not optimum at planting time we plant the nursery and then apply from 3/4 to 1 inch of water by irrigation. We have had good results using fairly large nozzles of the Rainbird #90 series.

Aphid Control --- Apids can be destructive, especially to seedling oat plants in Tifton area. We have modified a 5 ft. Gandy spreader to follow a tractor on 64 inch wheel width. With this equipment we can accurately apply Disyton or Thimet at 2 pounds (actual) per acre for aphid control. It often takes 2 or more applications at 4 week intervals to keep down aphids. The same spreader can be used for top-dressing with ammonium nitrate.

Weed Control --- Weeds are usually not a problem, but can be controlled by spraying with 2-4D using available tractor equipment. Weeds in the nursery alleys are controlled by cultivating with a tractor set on a narrow wheel width. Alleys are clean cultivated and kept smooth with a 2 x 6 mounted on a Ford frame. We do not use ryegrass or other cover in small grain nurseries.

Records and Marking --- Records are kept in a 300 page ledger book 11 x 14 inches in size. The double entry system is used and all rows and plots have different numbers.

The first replication of each test is marked by a large stake and a label 2 1/2" x 3 1/2" in size. India ink is used and a clear plastic is sprayed on the label. Smaller 12" x 1 1/8" white stakes mark other replications, head rows, etc.

Harvesting --- We still harvest by hand with sickles principally because of lodging. Yield plots consist of 8 feet of each of 2 inside rows. The heads of each plot are covered with an osnaburg bag 18" x 24" in size. If necessary, bundles are dried on a drier before threshing.

Threshing is done on a Vogel thresher. Storage is in paper bags placed in metal storage cabinets. Stored grain insects are troublesome and we have not yet solved the problem to our satisfaction.

Other Considerations --- Rabbits cause damage, especially to wheat plots. Birds also take their toll of oats about ripening time. Neither problem has been completely solved.

An idea for preparing trashy or fuzzy oats for planting has been borrowed from Don Bowman, Delta Station, Mississippi. Don runs them in a motor driven seed scarifier for a few seconds and then cleans them with an electric fan. With our type of nursery seeder, clean seed is very important, so we are using the scarifier treatment on chaffy oats.

Plant Breeding Methods --- Breeding and seed increase methods have been well described in previous Oat Newsletters; Jensen (1962), Poehlman (1963) and Thurman and Jones (1964). Briefly the methods at Tifton are as follows for oats, wheat and barley:

Crossing --- Crosses are made in the greenhouse during the winter. $F_o$ oat seeds (for growing $F_1$ plants) have been successfully grown at Aberdeen, Idaho. Barley and wheat seeds have not grown well at Aberdeen, probably due to dormancy.

$F_1$ Plants -- Oats grown at Aberdeen, Idaho. Barley and wheat in space plantings at Tifton, Georgia.

$F_2$ to $F_6$ -- Grown in bulk rod rows without selection. A few promising crosses are space planted each year and subjected to natural mildew and rust. Rows 6 feet long contain 10 plants each and 50 to 100 such rows accommodate a particular cross. Selected plants advance into the head row observation nursery and then into single rod rows.

Yield Testing --- Promising selections are usually included as additional entries in the Uniform Nursery and yield tested for at least 3 years.

Increases --- Another 5 ft. Gandy spreader has been modified and built into a 10 hole grain drill by J. L. Shepherd, Ag. Engineer, at the Coastal Plain Experiment Station. It mounts on a tractor with a 3 point hitch and uses the same "beds" as the nursery planter. Increase plots are planted with this Gandy drill in various amounts depending upon the seed stocks available.

Breeders Seed --- An increase field of from 2 to 4 acres is drilled with the Gandy drill so that tractor wheel middles can be used as walkways for rogueing the field. In other words, our increase fields are not drilled solid as a farmer would drill grain. If the new variety passes field and laboratory inspection by the Ga. Crop Improvement Association and is otherwise approved for naming and release, the breeders seed here produced will be turned over to Foundation Seeds, Inc., Athens, Georgia for further increase as Foundation seed.

## Sources of Resistance to Halo Blight in the USDA World Oat Collection

by C. P. Cheng and C. W. Roane

Seedlings of 4,530 entries of the USDA world oat collection were tested for reaction to halo blight (*Pseudomonas coronafaciens* (Elliot) Stevens). About ten seeds of each entry were sown in a 3" pot. When the plants were in the 3- to 4- leaf stage they were put into a fog chamber for 2-3 hours prior to inoculation in order to wet the leaves thoroughly and to create mild water congestion to enhance bacterial invasion. Inoculum was prepared by washing colonies of *P. coronafaciens* from the surface of (Difco) trypticase-soy agar plates which had been incubated for 24-36 hours at 25°C. This bacterial suspension was mixed with carborundum and sprayed on the seedlings with a compressed air atomizer. The inoculated seedlings were kept in the fog chamber for a period of 10-12 hours and then were dried slowly for a period of 10-12 hours. Plants were incubated at approximately 21°C. Four to six days after inoculation, symptoms began to appear and the seedling reactions were recorded on the 10th or 12th day according to the following scale:

| Reaction Class | Description |
|---|---|
| 1 | Immune or highly resistant, no lesions or chlorosis appeared. |
| 2 | Resistant, only a few restricted or tiny chlorotic spots appeared on leaf apices or margins. |
| 3 | Intermediate, necrotic lesions with spindle-shaped or round, chlorotic halos affecting less than one-half the blade area. |
| 4 | Susceptible, necrotic lesions with broad, chlorotic halos affecting more than one-half the blade area. |
| 5 | Highly susceptible, numerous necrotic lesions with broad, chlorotic halos coalescing over almost the entire blade; the upper half of the blades frequently twisted. |

The 4530 entries tested fell into the reaction classes with the following frequencies: 1-1; 2-25; 3-692; 4-3733; 5-79. The 26 entries which were considered resistant, classes 1 and 2, are as follows:

| Entry | C.I. or P.I. Number | Reaction Class |
|---|---|---|
| Yellow Peruvian | 975 | 2 |
| Cornellian | 1242 | 2 |
| Bicknell | 1353 | 2 |
| Frazier's Red Rust Proof | 1359 | 2 |
| Commercial White | 1387 | 2 |
| Vyto | 2160 | 2 |
| Fulghum X Swedish Select (1015 a2-1b) | 2555 | 2 |
| Winter Turf | 2683 | 2 |
| Burt | 2724 | 1 |
| Avena Victoria | 2764 | 2 |
| Clinton 59 | 4259 | 2 |
| Cornell 484a1-5-5 | 4269 | 2 |
| P820 Rpf. X H624-1-4 | 4450 | 2 |
| Stanton Strain 4 | 4566 | 2 |
| Combine Pedigreed Spring | 4630 | 2 |
| Marett's Winter Resistant Strain 6 | 5119 | 2 |
| Coker Bl. 47-63 | 5334 | 2 |
| Fulwin X Lee-Victoria X Bonda | 5380 | 2 |
| Wintok X (Clinton$^2$ X Santa Fe) | 5575 | 2 |
| Dubois | 6572 | 2 |
| Wintok X (Clinton$^2$ X Santa Fe) | 6740 | 2 |
| Saia | 7010 | 2 |
| Victorgrain 48-93 | 7125 | 2 |
| S.A. 13 | 244471 | 2 |
| No. 286 | 251581 | 2 |

| | | |
|---|---|---|
| Semiglabra 2167 | 258543 | 2 |
| Arlington (Check) | 4657 | 4 |

Although Dubois and Victorgrain 48-93 were free from halo blight in the field (Oat Newsletter 13:19-20), they gave a class 2 response in the greenhouse. Therefore, other varieties reacting with a class 2 response probably have excellent field resistance and should be tested in the field. Arlington was used as the susceptible check variety in these tests.

## Procedures Used in the Quebec Oat Breeding Project Group

by H. R. Klinck, MacDonald College of McGill University
and F. M. Gauthier, Laval University.

The concept of group participation to increase efficiency in cereal breeding and research programs is not new in Canada. In western Canada wheat breeders representing several research stations and other government agencies organized such cooperative programs as the "Project Group on Breeding Disease Resistant Spring Wheats for Manitoba and Eastern Saskatchewan" and the "Project Group on Breeding Spring Wheats for the Prairie Region", as early as 1950. Following their lead, similar groups were formed for other cereal crops and for most areas of Canada within a few years. University cereal breeders were also incorporated in these groups.

One such group, the Quebec Oat Project Group, was organized in 1957. The purpose of this article is to describe the organization of this group and to outline the breeding and testing procedures used. Participants in the group include representatives from the Canada Department of Agriculture Research Stations at Lennoxville, Normandin, L'Assomption, Caplan and La Pocatiere in Quebec, and at Kapuskasing, Ontario, as well as the authors. Oat breeding and selection work is done primarily at Macdonald College and La Pocatiere, and preliminary testing work is done at these two sites. More advanced (Screening) tests are conducted at each of the 8 locations noted, while final testing prior to licensing is done through a cooperative testing program which involves the Ontario and Atlantic project groups as well.

The general scheme used in the development and release of a new variety is portrayed in Figure 1. Crossing and selection procedures described here are those in use at Macdonald College. Those employed at La Pocatiere are similar, although modifications in plot sizes and handling procedures are necessitated by the equipment used.

Plot sizes and equipment used -- In the discussion which follows, the following terms are used and are described here for clarification:

Nursery plots, space-planted plots, or "centgeners" are plots consisting of 2, 3 or more rows, 8 inches apart, with 31 plants per row. Plant spacing within the row approximates 2-1/2 inches. These are usually hand seeded, into open furrows, taking care to insure uniform spacing. Seeds are covered mechanically.

Observational plots are plots containing 4 rows, 8 or 9 inches apart, and about 7 feet long. These are seeded at Macdonald College with a 5-row cone-seeder mounted on a Bolen's Ridemaster tractor, and at La Pocatiere with either a V-belt seeder or a manually operated single-cone seeder.

Test plots are plots comprised of either 5 rows, 8 inches apart and 14-1/2 feet long, or 4 rows, 9 inches apart and 18-1/2 feet long. These are also seeded mechanically.

Harvesting of test plots at Macdonald College is normally accomplished through the use of a Gravely tractor with a sickle bar and straw pan. Cut sheaves are wrapped in jute sacking to prevent losses, hung indoors to dry, then threshed with a Vogel plot thresher. At La Pocatiere, plots are harvested with hand sickles and threshed with a Kemp plot thresher.

Objectives --- In developing new oat varieties in Quebec, the primary objectives include better lodging resistance, higher yields, improved quality, and resistance to smuts, rusts and Septoria blight. In addition, the program is designed to develop varieties with wide adaptation, seemingly a necessity in an area with the extremes of soil and climatic variability prevalent in Quebec.

Crossing --- Crosses are usually made in the greenhouse during the winter, although in some seasons this work is done in the field. Greenhouse crossing is preferred because fewer risks are involved.

$F_1$ --- The $F_1$ plants are normally grown in the greenhouse where there is less danger of losing them either in the seedling stage or from birds during the ripening period. Six-inch plastic pots are used, with either 1 or 3 plants per pot, depending on space available and the material involved.

On occasion, $F_1$ hybrid plants are started in 4-inch pots in the greenhouse in March, then transplanted to the field as spaced plants.

Segregating generations --- Material in the breeding program is carried primarily under the pedigree system. In each cross a space-planted $F_2$ population of 1,000-2,000 plants is grown. These and/or the later generations are subjected to artificially induced epidemics of stem rust and/or crown rust in the field, depending on the potential resistance inherent in the cross. Crosses carrying genes for resistance to the smuts are also inoculated during two or more generations to permit selection of resistant types.

From each $F_2$ population approximately 150-200 plants are retained. These plants are chosen on the basis of grain type, disease resistance, apparent straw strength and general vigour. From each $F_2$ plant 62 seeds are space-planted in a 2-row $F_3$ "centgener". Rigorous selection is made among the $F_3$ plots in the field, picking out the most desirable appearing progenies and reducing the numbers drastically. The remaining plots are hand pulled and taken to the laboratory for selection during the winter. Check plots usually occur within 50 feet or any nursery plot and serve as a basis of selection for disease or lodging resistance, maturity, etc.

From each harvested $F_3$ plot 5 to 10 plants are selected. These are again space-planted in 2-row centgeners in $F_4$. The process is repeated for $F_5$ and $F_6$ with rigorous field selection and deletion. In $F_6$ the centgeners are increased to 3 rows. Usually the number of $F_6$ plots retained averages about 30 for each cross. In the laboratory approximately 10 plants are selected from each plot. Nine of these are bulked to provide seed for Observational plots while one is retained for a 3-row space-planted plot in the $F_7$.

In all nursery plot work the oat centgeners are separated by a row or two of barley filler. The primary purpose of this is to prevent inter-plot contamination either through lodging or from seeding or harvesting errors.

## Testing phase

### Observational plots

The bulked seed from the $F_6$ plants is thoroughly mixed and divided into two parts. One part is used to seed Observational plots at Macdonald College, the other to seed similar plots at La Pocatiere. Since material entering the Observational plots arises from the breeding and selection work at both locations, an exchange of materials takes place at this point in the program. In establishing the Observational tests a common check variety is repeated every sixth plot. These are used as a base for evaluating the $F_7$ progenies. For a number of years the evaluation and subsequent deletions were based on a visual method of scoring by the authors, always working as a team. Entries that did not appear to be as high yielding as the closest recurring checks were scored down and deleted. Recent correlation studies between visual scorings and measured yields relative to the adjacent checks have revealed that the best progenies cannot always be selected visually. Hence, yields are now taken on all Observational plots that have not been discarded because of weak straw, disease, etc. Only those entries performing well at both locations are retained. This normally represents about 25-30% of the entries.

From each $F_7$ space-planted plot corresponding to those retained from the Observational test 20 heads are taken at random. The balance of the plot is harvested in bulk as a source of seed for Preliminary tests. The heads are examined in the laboratory and reduced to a maximum of 15 with similar panicle and seed characteristics. These are used to establish space-planted head rows in $F_8$.

### Preliminary tests and head rows

Progenies surviving the Observational tests are entered in replicated Preliminary tests at the 2 locations, along with 2 or 3 check varieties. This is either repeated the following year, or the material moved on to the Screening tests, depending on the crosses involved and the reliability of the tests in a given season. The originating station for a given entry is responsible for maintaining the seed stocks for these and later tests. The number of entries surviving the Preliminary tests is seldom over 50%.

The 15 Head rows, grown side by side, are examined at various stages of growth during the summer for uniformity. Any off-type rows are discarded. If variability at this stage is extreme the material may be moved back a step or two in the program for further purification and retesting.

### Screening tests and pure seed plots

Following the Preliminary testing phase the remaining progenies are entered in Screening yield tests at 7 locations in Quebec and 1 in Ontario.

For most entries this is the final test and they are discontinued. The best ones, usually not exceeding 2 or 3, proceed to the Cooperative tests.

Parallel to the Screening tests is the maintenance of the entries in Pure Seed plots. These plots are designed to produce 5-10 pounds of seed and are handled in such a manner as to insure absolute purity. Seed from these plots is used for subsequent tests and for the establishment of Breeder stock in the case of a new release.

Cooperative tests and Breeder head rows

The Eastern Cooperative Oat tests usually involve about 20 varieties, comprising the best selections from the Ontario, the Atlantic and the Quebec Project Groups, and new varieties or very promising strains from other locations. An entry in these tests, conducted at 12 locations in eastern Canada, is retained for a maximum of 3 years. At the end of this testing period a decision is taken regarding its release as a new variety.

Coincided with entry in the Cooperative tests is the establishment of Breeder head rows. These are grown from approximately 100 heads taken at random from the pure seed plot of the previous year. Off-type rows are discarded. The remaining rows are harvested separately and are continued as 3-row plots the following year. After removal of one half of the center row of each plot - to maintain the individual lines - seed from all plots is bulked and used to establish an area for the production of Breeder stock. Whether or not this latter step is taken depends on the fate of the potential new variety. If it is not released, seed stocks are destroyed or retained for future breeding purposes.

Varietal release and regional testing

The release of a new variety for farm production can only be made after a license has been granted by the Canada Department of Agriculture. Breeder seed of a licensed variety is released to Foundation growers and the variety ultimately finds its way to the farmers through normal seed production channels.

Recommendations of varieties to farmers in Quebec are based on a local (regional) testing system under the auspices of the Quebec Seed Board. These test comprise standard varieties and very promising new entries from the cooperative tests. Usually by the time a variety is licensed at least 2 years of local test data have been accumulated. Thus, recommendations can be made as soon as seed stocks are available in sufficient quantity.

Modifications of the basic program

While the pedigree system is used primarily, some crosses are carried during the segregating generations as unselected bulk plots. Where this is done, head selections are made in $F_6$ or $F_7$ and these move through head rows and into the observational tests.

Use is made of greenhouse facilities for disease tests, such as for determining resistance to specific races of rust, or for advancing a generation without critical selection.

Fig. 1. OAT BREEDING AND TESTING SCHEME - QUEBEC PROJECT GROUP

| | | |
|---|---|---|
| Year 1 | Hybridization - usually 3 - 6 crosses per year at each station<br>First generation hybrids - grown in greenhouse during winter | |
| Years 2 - 6 | Selection - 5 or 6 generations | |
| Year 7 | Observation plots<br>(2 locations)<br>(100 - 150 progenies) | Final selection |
| Year 8 | Preliminary yield tests<br>(2 locations)<br>(30 - 60 entries) | Head rows |
| Year 9 | Preliminary yield tests<br>(2 locations)<br>(25 - 50 entries) | Pure seed plots |
| Year 10 | Screening yield tests<br>(7 locations in Que.,<br>1 in Ontario)<br>(15 - 25 entries) | Pure seed plots |
| Years 11 - 13 | Co-operative yield tests<br>(12 locations in Eastern Canada)<br>(20 - 25 varieties) | Breeder head rows<br>Breeder plots |
| Year 13 | License and release of new variety | Breeder stock |
| Years 12 - 14 | Local (regional) yield tests<br>(15 - 20 locations in Quebec)<br>(5 - 8 varieties) | Foundation stock |
| Year 15 | Quebec Seed Board Recommended List | Registered stock<br>Certified stock |

# Oats for Winter Pasture[1]

by A. D. Day and R. K. Thompson[2]

Small grains can be used to produce high quality pasture during the winter months in southern Arizona. An experiment was conducted over a 3-year period (1963-65) at Mesa, Arizona to compare simulated pasture forage yields from oats, barley and rye. The experimental design was a Randomized Block with four replications. Markton oats, Harlan barley, and Elbon rye were the varieties used. The grains were planted in October and the forage was harvested at the jointing stage of growth three inches above the ground level. Six harvests were made during the growing season. The recommended cultural practices for growing small grains for pasture in southern Arizona were used in this study.[3]

The average ovendry simulated pasture forage yields from Markton oats, Harlan barley, and Elbon rye are presented in Table 1. A severe freeze in January, 1963 destroyed part of the stand of Markton oats and Harlan barley and retarded their pasture readiness. In 1964 and 1965, both Markton oats and Harlan barley were seriously damaged by the Barley Yellow Dwarf Virus Disease. Despite these adverse conditions, oats and barley produced 14 and 9 percent more pasture, respectively, than rye. Oats pasture was more uniformly distributed over a longer period than barley or rye. Oats appear to be the most desirable small grain for winter pasture production in southern Arizona.

Table 1. The 3-year average (1963-65) oven-dry pasture forage yields from Markton oats, Harlan barley, and Elbon rye at Mesa, Arizona. Grazing was simulated by clipping six times each season at the onset of the jointing stage of growth.

| Variety and crop | Yield in % of Elbon rye |
|---|---|
| Markton oats | 114 |
| Harlan barley | 109 |
| Elbon rye | 100 |
| Yield of Elbon rye calculated in tons per acre | 1.84 |

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[1]Contribution from the Arizona Agricultural Experiment Station, University of Arizona, Tucson, Arizona.

[2]Agronomist and Research Associate in Agronomy, Arizona Agricultural Experiment Station, Tucson, Arizona, respectively.

[3]Day, A. D. and R. E. Dennis. 1965. Barley in Arizona. Cooperative Arizona Extension Servie and Agricultural Experiment Station. Bulletin A-15. 20 p.

Report of Expert Group Assembled to Consider "International Standardization of Procedures for Integration and Mechanization of Crop Research Data Recording and Processing" -- Held at the International Atomic Energy Agency, Vienna, December 13-17, 1965; (Ed.--Submitted to Oat Newsletter by C. F. Konzok)

Introduction --

At the invitation of the Directors General of the Food and Agriculture Organization of the United Nations (FAO) and the International Atomic Energy Agency (IAEA), a group of scientists assembled in Vienna, at the Headquarters of the International Atomic Energy Agency, from December 13 to 17, 1965, to provide expert advice on the development of a programme of International Standardization and Integration of Crop Research Data Recording and Processing in relation to their programmes on application of isotopes and radiation in agriculture.

The advice of the scientists was sought to aid the Joint FAO/IAEA Division of Atomic Energy in Agriculture in carrying out its responsibilities for work on the classification of mutants in crop plants, the handling of uniform research experiments in soils and plant breeding, as well as experiments in which the Joint Division cooperate with the FAO Division of Plant Production and Protection. Of particular concern was the desire to use methods of recording data that were consistent with standard methods in general use in plant breeding, soils and related research.

Moreover, as many nations are presently preparing for the International Biological Programme, it seemed appropriate that urgent consideration be given to the standardization of recording procedures so that maximum benefit to all cooperating nations could be achieved.

The invited group of experts were:

S. Borojevio, Institute for Agricultural Research
Maksima Gorkog 30, Novi Sad, Yugoslavia

T. T. Chang, International Rice Research Institute
Los Banos - Laguna, The Phillipines

E. H. Everett, Michigan State University, Dept. of Crop Science
East Lansing, Michigan, U.S.A.

K. W. Finlay, University of Adelaide, Waite Agricultural
Research Institute, Private Bag No. 1
Glen Osmond, S. Australia

E. G. Heyne, Department of Agronomy, Kansas State University
Manhattan, Kansas, U.S.A.

P.R. Jennings, International Rice Research Institute
Los Banos - Laguna, The Phillipines

C. F. Krull, The Rockefeller Foundation
Calle Londres 40, Mexico 6, D.F., Mexico

A. F. Kelly, National Institute of Agricultural Botany
Huntingdon Road, Cambridge, U.K.

J. MacKey, Department of Genetics and Plant Breeding
Royal Agricultural College of Sweden, Uppsala 7, Sweden

O. Nissen, Agricultural College of Norway
Vollebekk, Norway

C. A. Watson, Agricultural Experiment Station
College of Agriculture, Montana State University
Bozeman, Montana, U.S.A.

Staff members of FAO and IAEA present were:

C. F. Konzak, Special Advisor to the Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna (on leave from Washington State University, Pullman, Washington, U.S.A.) (Scientific Secretary).

M. Fried, Director, Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna

J. Vallega, Director, Division of Plant Production and Protection, FAO, Rome

R. A. Silow, Deputy Director, Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna

P. Attree, Division of Research and Laboratories, IAEA, Vienna

Y. Barrada, Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna

F. Hoyos, Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna

B. Sigurbjornsson, Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna

T. Scott, Division of Scientific and Technical Information, IAEA, Vienna

Discussion --

A general description of various local and international research programmes, including the computer handling of data within some of them was presented to assist in defining their common features and to provide a broad concept as a framework for further discussion.

In their discussion, the scientists stressed that some methods of data recording now in use should be reassessed to facilitate their use by modern electronic data processing equipment. The experts unanimously agreed that there was an urgent need to develop ways to encourage and facilitate the interchange of the rapidly growing volume of information relating to the world plant germ plasm pool. They encouraged a standardization of rules of identification and scoring suitable for computer processing which would enable universally intelligible data to be used by individual researchers, or stored and exchanged through a central international agency as required.

It became clear that, in addition, general principles for international standardization of recording crop plant research data could be widely acceptable while maintaining flexibility for important avenues of scientific individuality.

The following recommendations arose from detailed consideration of these concepts:

Recommendations --

The experts recommend that:

I. Internationally recognized principles of terminology and data recording adapted to computer processing be established and applied uniformly within and between allied research fields.

II. A programme to be known as "The International Programme on the Standardization of Crop Research Data Recording" should be set up cooperatively by the FAO Plant Production and Protection Division and the Joint FAO/IAEA Division of Atomic Energy in Agriculture, with the development of "Reccommendation I" as its prime objective.

The group of scientists unanimously stressed the urgent need to initiate the above recommendations and offered their continued servies to the two Divisions to set up a programme to achieve this end. As a first step, a working group consisting of C. F. Konzak (leader); K. W. Finlay; C. F. Krull; E. G. Heyne and A. F. Kelly was nominated (it was recommended that others also be contacted) to undertake the following necessary work in close cooperation with J. L. Tessi, Y. T. Mao and other relevant staff of FAO, IAEA, the Rockefeller Foundation, and other organizations concerned:

a) to assist in the reorganization of central files of world plant germ plasm records;

b) to establish principles and procedures for scoring data. (Some of the principles basic to the whole concept of crop data recording systems were considered. Recommendations concerning these principles are attached).

c) to design standard forms for reporting information.

d) to formulate rules for assigning accession numbers and for entering information on world plant germ plasm.

f) to initiate publicity to encourage the cooperation and coordination with other groups, such as International Wheat and Barley Genetics Committees and the International Association on Mechanization of Field Experiments, and the Coordinated Programme of Research on the Production and Use of Induced Mutations in Plant Breeding.

e) to initiate pilot tests of suggested standardized systems.

g) to foster greater economy in the establishment of local research programmes by the development and/or collection and making available of computer programmes and flow charts for handling of records and data used regularly in crop research experiments.

h) to develop methods for mechanizing reproduction and distribution of information to improve communication between individuals and groups engaged in crop research.

III. Existing international organizations be responsible for the accumulation and dissemination of information on identification and performance of world plant germ plasm.

As the FAO Division of Plant Production and Protection, Rome, presently maintains records of Internation Genetic Stocks of Wheat and Barley, the International Rice Research Institute, Manila, is developing records of World Rice Germ Plasm, and the Joint FAO/IAEA Division of Atomic Energy in Agriculture, Vienna, is developing records of induced mutant strains in crop plants, it is appropriate that these agencies continue these functions. In the latter case, these records should also be duplicated in any relevant World Crop Plant Germ Plasm records.

IV. A review take place before the end of December 1966, to consider the results of actions taken by the working group recommended herein and to start into operation world plant germ plasm record systems.

C. F. Konzak
Scientific Secretary

Appendix A --

Preliminary general recommendations regarding the identification and description of genotypes and the scoring and measurement of their responses to environment in a system suitable for computer processing.

I. Information Handbook

A handbook describing recommended procedures of naming, numbering and coding should be compiled by crops and made available to all workers.

II. Identification of genotypes

A. Country Codes

Universal acceptance of a hierarchal system of 2-letter codes assigned to international, national and station accessions is essential. The letters UN might be assigned to the highest order, the international agency, accession. The codes assigned to national accession systems might generally follow the international country automobile identification codes. If the automobile code uses only one letter, another should be added facilitating the recognition of the English name of the country. If the resulting codes then duplicate one already allocated, the indigenous name of the country would have second priority. Three-letter country codes should be reduced to two letters, according to a similar priority system. These codes should permit ready recognition of national and international series. Suggested national codes are herewith enclosed.

Station accession series should follow a similar two-letter system independent of the nation code. If possible, duplication with neighboring or closely cooperating countries should be avoided and the specific code of the country should not be used again in a lower hierarchy system.

Lowest order, local accession series, might use a single letter and a number in either of the two positions allotted for accession series codes. A more detailed discussion of this approach is given in a proposal by Konzak in this newsletter.

B. Accession Number

Six arabic numerals should follow the accession code to form the complete identification number for each crop.

C. Crop Codes

Each crop should be further identified by a simplified crop code, based on a combination of two letters. In principle, the coded unit should comprise one genus, but related genera of interest such as donors of useful genetic trials, might also be included. In addition, closely related genera might be grouped together for other reasons. This universal crop identification code should suggest the Latin name of the genus with preference for the more important crop in case of duplication.

To the extent possible, closely related crops from a breeding point of view; i.e., crops that may be handled by one breeder, should be coded to facilitate machine sorting.

The following crop codes are suggested as examples and recommended for immediate use:

| | |
|---|---|
| Barley (*Hordeum* L.) | HO |
| Maize (*Zea* L.) and allied genera (including *Euchlaena* Schrad., *Tripsacum* L.) | ZE |
| Oats (*Avena* L.) | AV |
| Rice (*Oryza* L.) | OR |
| Rye (*Secale* L.) | SE |
| Wheat and allied genera (*Triticum* L., *Aegilops* , *Agropyron* L., *Haynaldia* and *Triticale*) | TR |

Each crop or crop group should be subdivided into a hierarchy of maximal two subgroups only in the master record. A certain consistency in this subgrouping is desirable but maximum convenience in each case should have priority.

As examples, the subgrouping of wheat may be as follows:

| Subgrouping of 1st order: | Subgrouping of 2nd order: |
|---|---|
| 0 hexaploid *Triticum* | 0 winter habit, red seeds |
| 1 tetraploid " | 1 " " amber seeds |
| 2 diploid " | 2 " " white seeds |

| | | | |
|---|---|---|---|
| 3 | octoploid _Triticale_ | 3 | spring habit, red seeds |
| 4 | hexaploid " | 4 | " " amber seeds |
| 5 | _Aegilops_ | 5 | " " white seeds |
| 6 | _Agropyron_ | | |
| 7 | _Haynaldia_ | | |

The subgrouping of rice may use the following scheme:

| Subgrouping of 1st order: | | Subgrouping of 2nd order: | |
|---|---|---|---|
| 0 | _O. glaberrima_ | 0 | non-glutinous |
| 1 | _O. sativa_ conv. _indica_ | 1 | glutinous |
| 2 | _O._ " _japonica_ | | |
| 3 | _O._ " _javonica_ | | |

D. Variety name

The naming of varieties should follow the rules outlined by the International Code of Nomenclature for cultivated plants of the International Union of Biological Sciences. Names of cultivars and experimental materials should be constructed using only the 26 Roman letters A to Z, ten Arabic numerals, 0 - 9, and the supplementary symbols available on most computing equipment; i.e., asterisk *, equal =, plus +, minus -, period ., comma ,, left and right parentheses (), slash /, and quotation mark ' and blank. Roman numerals should not be used. Lower case and super and subscript letters and numbers are not available. In order to discourage the use of extremely long names and permit machine duplication, not more than 32 machine spaces should be allocated.

The following rules should also be applied in recording cultivar names:

a) In the case of named cultivars

1. Write name in full
2. Where names consist of a combination of letters and numbers, include both; e.g., Atlas 66
3. Names that are essentially numbers, use all the numbers; e.g., Mo. B-475.
4. Use the recognized transliteration procedures when necessary
5. No translation.

b) In the case of unnamed experimental material

1. Identify by presenting the parentage, in as far as possible, rather than local, state, or national numbers, which will instead be identified through accession series codes.
2. It is preferable to use a uniform system of writing the pedigree; e.g., Wiebe's system, as modified for punch cards by Konzak (in this newsletter).

c) Collections

Collections should be identified by COL, followed by the area where collected and include the organization making the collection when space is available; e.g., COL/IRAQ/1965/JAPAN EXP.

d) In order to give more information concerning a parentage in 32 spaces, abbreviations may be used; however, write the names in full when possible. The United States system of abbreviating as published in the Agronomy Journal, Vol. No. 52:613, 1960, however, is suggested as a guide. Several abbreviation procedures should be noted:

1. Five-letter names should not be abbreviated.
2. Abbreviations with three letters or less are preferred.
3. Send to FAO the key to any abbreviations that are used for cultivar names.

III. Variety Description

The morphological features used to characterize variety should be meaningful, briefly describing the parts of the plant, fruiting body (head, panicle or flower), fruits and seeds.

IV. Scoring and Measurement of Plant Responses to Environment

1. Wherever possible, actual values should be recorded and the metric system of measurement should be used.

2. When responses are scored in percentages, the recording scale should be in percentages (00 - 99).

3. When responses are codes, they should be recorded in 10 equal classes (0 - 9). It is preferable to have 0 be zero, 1 is low, 5 is intermediate, and 9 is the most of whatever character is rated. An international system of illustrated ratings and codes should be established for:

i) Disease reactions
ii) Insect reactions
iii) Physical measurements
iv) Physiological characters
v) Chemical measurements

Where satisfactory codes exist, they should be considered for general use.

4. A blank in the record should uniformly designate 'no information'.

Appendix B --

Preliminary specific recommendations regarding essential information in a world plant germ plasm record system.

A. Format and Recording

1. Format for Record System

It was generally agreed that the FAO World Catalogue of Genetic Stocks provided a useful basis for the development of a format for the accumulation of records.

2. Method of Recording Procedures

The procedures to be applied when recording information such as the country code, accession No., crop codes, variety names and principles for scoring plant responses to environment should be as described in Appendix A.

3. Pedigree

A full pedigree for each genotype should be supplied if available and should preferably be written according to a uniform system; e.g. Wiebe's system, as modified for punch cards by Konzak.

4. Origin of Accession

The following five categories are suggested as a basis for describing the origin of accession:

0 Unknown
1 Introduction
2 Local "land races" and wild forms
3 Local bred cultivars
4 Experimental stocks

5. Place of Origin and Maintenance

a) Name of country and station where stock originated
b) Name of country and station submitting information
c) Name of country and station from which stock can be obtained.

Two-letter codes for country (as referred to previously) and a two-letter or -number code for station should be adopted.

6. Registration of New Accessions

When a new accession is registered, apart from the identification codes above, details of description and response to environmental factors should reflect the performance of that accession in the environment of the registering station. This record would then become the 'type' description of the accession.

B. Active File

It was agreed that the system should also be capable of the receiving, storing, sorting and recovering of new information on the performance of accessions in other environments; this part of the system should be independent of the original submitted records (as in A above) which would remain as submitted. Special attention is recommended in this file to insert types carrying specific genes, gene segments or chromosomes of agronomic, genetic or cytological value.

C. Services that could be provided from Central Agency Files

The use of computers would provide more efficient and extensive service to research workers. Some of the services might be:

1. Lists - contents of file and codes by crop

a) Periodic updating of local records
b) Annual or biannual lists by crops

2. Search of files on request for genotypes possessing particular characteristics (e.g. resistance to disease of specific mutant strains). Continual updating of 'active file' would add greatly to the value of this service.

3. Lists of required genotypes printed in form of field book pages.

4. Supply of 'master cards' for updating local systems.

5. Surveys of world distribution of various characters on request.

6. Order book - names and addresses of stock perpetuators.

## Two-letter Codes

(Ed.-Submitted to Oat Newsletter by C. F. Konzak)

The following lists are a preliminary attempt to set up two-letter national codes. List No. 1 includes the two-letter automobile codes that already exist. List No. 2 includes countries with one and three-letter automobile codes, and those from which the auto code was not known. The existing code, if known, is given and the suggested code change is presented.

These lists are probably incomplete and in some cases probably in error. However, the lists are presented here as being only preliminary.

### List No. 1

ALPHABETICAL/CODE

| Code | Country |
|---|---|
| AL | Albania |
| BG | Bulgaria |
| BH | British Honduras |
| BL | Basutoland |
| BP | Bechuanaland |
| BR | Brazil |
| BS | Bahama Islands |
| CB | Congo |
| CH | Confederation Helvetica (Switzerland) |
| CL | Ceylon |
| CO | Colombia |
| CR | Costa Rica |
| CS | Czechoslavakia |
| CU | Curacao |
| CY | Cyprus |
| DK | Denmark |
| DY | Dahomey |
| DZ | Algeria |

ALPHABETICAL/COUNTRY

| Country | Code |
|---|---|
| Albania | AL |
| Algeria | DZ |
| Argentina | RA |
| Bahama Islands | BS |
| Basutoland | BL |
| Bechuanaland | BP |
| Bolivia | RB |
| Brazil | BR |
| British Honduras | BH |
| Bulgaria | BG |
| Cameroon | TC |
| Ceylon | CL |
| China | RC |
| Colombia | CO |
| Confederation Helvetica (Switzerland) | CH |
| Congo | CB |
| Costa Rica | CR |
| Curacao | CU |

ALPHABETICAL/CODE

| Code | Country |
|---|---|
| EC | Ecuador |
| EL | El Salvador |
| ET | United Arab Republic |
| FL | Liechtenstein |
| GA | Gabon |
| GB | Great Britain (England) |
| GH | Ghana |
| GR | Greece |
| HK | Hong Kong |
| IL | Israel |
| IR | Iran |
| IS | Iceland |
| JA | Jamaica |
| MA | Morocco |
| MC | Monaco |
| MS | Mauritania |
| MW | Malawi |
| NA | Neth. Antilles |
| NL | Netherlands |
| NZ | New Zealand |
| PA | Panama |
| PE | Peru |
| PI | Philippines |
| PL | Poland |
| PY | Paraguay |
| RA | Argentina |
| RB | Bolivia |
| RC | China |
| RH | Haiti |
| RI | Indonesia |
| RL | Lebanon |
| RM | Malagasy Republic |
| RU | Urundi |
| SD | Swaziland |
| SF | Finland |
| SK | Sarawak |
| SN | Senegal |
| SP | Somiland |
| SU | Soviet Union |
| SY | Seashell Islands |
| TC | Cameroon |
| TG | Togo |
| TN | Tunisia |
| TR | Turkey |
| TT | Trinidad-Tobago |
| VN | Viet Nam |
| YU | Yugoslavia |
| YV | Venezuela |
| ZA | Union of South Africa |

ALPHABETICAL/COUNTRY

| Country | Code |
|---|---|
| Cyprus | CY |
| Czechoslavakia | CS |
| Dahomey | DY |
| Denmark | DK |
| Ecuador | EC |
| El Salvador | EL |
| Finland | SF |
| Gabon | GA |
| Ghana | GH |
| Greece | GR |
| Great Britain (England) | GB |
| Haiti | RH |
| Hong Kong | HK |
| Iceland | IS |
| Indonesia | RI |
| Iran | IR |
| Israel | IL |
| Jamaica | JA |
| Lebanon | RL |
| Liechtenstein | FL |
| Malagasy Republic | RM |
| Malawi | MW |
| Mauritania | MS |
| Monaco | MC |
| Morocco | MA |
| Netherlands | NL |
| Neth. Antilles | NA |
| New Zealand | NZ |
| Panama | PA |
| Paraguay | PY |
| Peru | PE |
| Philippines | PI |
| Poland | PL |
| Sarawak | SK |
| Seashell Islands | SY |
| Senegal | SN |
| Somaliland | SP |
| Soviet Union | SU |
| Swaziland | SD |
| Togo | TG |
| Trinidad-Tobago | TT |
| Tunisia | TN |
| Turkey | TR |
| Union of South Africa | ZA |
| United Arab Republic | ET |
| Urundi | RU |
| Venezuela | YV |
| Viet Nam | VN |
| Yugoslavia | YU |

No. 2 List

ALPHABETICAL/SUGGESTED CODE

| Sugg. Code | Country | (present code, if any) |
|---|---|---|
| AD | Aden | (ADN) |
| AF | Afghanistan | |
| AG | Angola | (PAN) |
| AN | Andorra | (AND) |
| AR | Saudi Arabia | (SAUD) |
| AS | Austria | (A) |
| AU | Australia | (AUS) |
| BB | Barbados | (BDS) |
| BE | Belgium | (B) |
| BG | British Guiana | (BRG) |
| BN | Burundi | |
| BT | Bhutan | |
| BU | Burma | (BUR) |
| CA | Chad | |
| CE | Chile | (RCH) |
| CG | Congo Republic | (CGO) |
| CN | Canada | (CDN) |
| CT | Central African Republic | (RCA) |
| CU | Cuba | (C) |
| DL | Germany | (D) |
| DO | Domican Republic | (DOM) |
| EI | Ireland | (IRL) |
| EO | Ethiopia | (ETH) |
| ES | Spain | (E) |
| FG | French Guiana | |
| FM | Malaysia | (PTM) |
| FR | France | (F) |
| GI | Guinea | |
| GM | Gambia | (WAG) |
| GT | Guatemala | (GCA) |
| HO | Honduras | (HOND) |
| HU | Hungary | (H) |
| IC | Ivory Coast* | (CI) |
| IN | India | (INDIA) |
| IQ | Iraq | (IRQ) |
| IT | Italy | (I) |
| JO | Jordan | (JOR) |
| JP | Japan | (J) |
| KE | Kenya | (EAK) |
| KM | Cambodia | (K) |
| KO | Korea | (KORE) |
| KW | Kuwait | (KWT) |
| LA | Laos | (LAO) |
| LB | Libya | (LIBY) |
| LX | Luxemburg | (L) |
| ML | Mali | (RMM) |
| MR | Mongolian Republic | |
| MT | Malta | (GBY) |

ALPHABETICAL/COUNTRY

| Country | (present code, if any) | Sugg. Code |
|---|---|---|
| Aden | (ADN) | AD |
| Afghanistan | | AF |
| Andorra | (AND) | AN |
| Angola | (PAN) | AG |
| Austria | (A) | AS |
| Australia | (AUS) | AU |
| Barbados | (BDS) | BB |
| Belgium | (B) | BE |
| Bhutan | | BT |
| British Guiana | (BRG) | BG |
| Burma | (BUR) | BU |
| Burundi | | BN |
| Cambodia | (K) | KM |
| Canada | (CDN) | CN |
| Central African Republic | (RCA) | CT |
| Chad | | CA |
| Chile | (RCH) | CE |
| Congo Republic | (CGO) | CG |
| Cuba | (C) | CU |
| Domincan Republic | (DOM) | DO |
| Ethiopia | (ETH) | EO |
| France | (F) | FR |
| French Guiana | | FG |
| Gambia | (WAG) | GM |
| Germany | (D) | DL |
| Guatemala | (GCA) | GT |
| Guinea | | GI |
| Honduras | (HOND) | HO |
| Hungary | (H) | HU |
| India | (INDIA) | IN |
| Iraq | (IRQ) | IQ |
| Ireland | (IRL) | EI |
| Italy | (I) | IT |
| Ivory Coast* | (CI) | IC |
| Japan | (J) | JP |
| Jordan | (JOR) | JO |
| Kenya | (EAK) | KE |
| Korea | (KORE) | KO |
| Kuwait | (KWT) | KW |
| Laos | (LAO) | LA |
| Libya | (LIBY) | LB |
| Luxemburg | (L) | LX |
| Malaysia | (PTM) | FM |
| Mali | (RMM) | ML |
| Malta | (GBY) | MT |
| Mexico | (MEX) | MX |
| Mongolian Republic | | MR |
| Mozambique | (MOC) | MZ |

* A change here is suggested, because of duplication with CI, U.S. Cereal Investigations Ident.

| ALPHABETICAL/SUGGESTED CODE | | |
|---|---|---|
| Sugg. Code | Country | (present code, if any) |
| MX | Mexico | (MEX) |
| MZ | Mozambique | (MOC) |
| NC | Nicaragua | (NIC) |
| NI | Nigeria | (NIG) |
| NO | Norway | (N) |
| NP | Nepal | |
| NR | Niger | (NIG) |
| PK | Pakistan | (PAK) |
| PT | Portugal | (P) |
| RD | S. Rhodesia | (RSR) |
| RO | Rumania | (R) |
| RW | Rwanda | (RWA) |
| SA | Sudan | (SUDA) |
| SI | Sikkim | |
| SL | Sierra Leone | (WAL) |
| SM | Surinam | (SME) |
| SO | Rep. San Marino | (RSM) |
| SR | Syria | (SYR) |
| SS | Spanish Sahara | |
| SW | Sweden | (S) |
| TH | Thailand | (T) |
| TZ | Tanzania | (EAT) |
| UG | Uganda | (EAU) |
| UR | Uruguay | (U) |
| US | United States | (USA) |
| VO | Volta | |
| ZB | Zambia | (Z) |

| ALPHABETICAL/COUNTRY | | |
|---|---|---|
| Country | (Present code, if any) | Sugg. Code |
| Nepal | | NP |
| Nicaragua | (NIC) | NC |
| Niger | (NIG) | NR |
| Nigeria | (NIG) | NI |
| Norway | (N) | NO |
| Pakistan | (PAK) | PK |
| Portugal | (P) | PT |
| Rumania | (R) | RO |
| Rwanda | (RWA) | RW |
| San Marino (Rep.) | (RSM) | SO |
| Saudi Arabia | (SAUD) | AR |
| Sierra Leone | (WAL) | SL |
| Sikkim | | SI |
| Spain | (E) | ES |
| Spanish Sahara | | SS |
| S. Rhodesia | (RSR) | RD |
| Surinam | (SME) | SM |
| Sudan | (SUDA) | SA |
| Sweden | (S) | SW |
| Syria | (SYR) | SR |
| Tanzania | (EAT) | TZ |
| Thailand | (T) | TH |
| Uganda | (EAU) | UG |
| United States | (USA) | US |
| Uruguay | (U) | UR |
| Volta | | VO |
| Zambia | (Z) | ZB |

## Better Straw in Oats

by F. A. Coffman

Efforts to breed disease resistant oats have resulted in less attention being given to the improvement of agronomic characters in the crop. Yet much progress has been made. Increased test weight, better straw and winter-hardiness are such.

A half-century ago Richland and Gopher, among early spring, and the midseason Victory, and more recently Bannock, were considered as having "good straw". Now all such are considered relatively "weak-strawed". However, the progress made in producing better straw in oats has resulted primarily as a "by-product" of disease breeding programs as even yet no extensive, long-continued program directed primarily toward breeding oats with better straw has been reported.

Consequently nothing has been accomplished in oats as to improved straw that can be compared with what O. A. Vogel of Washington State has brought about in wheat for the Northwest. His tremendously productive, dwarf-strawed wheats border on the fabulous. They prompted Dallas Western, of Quaker Oats to ask recently "Why have oat breeders not followed Vogel's lead?"

Despite lack of extensive projects directed toward breeding stiffer strawed oats, much progress has been made. Examples are H. C. Murphy's Clinton and the late George Wild's Victorgrain, among spring and winter oats, respectively. Recent advances may well surpass these two "straw checks", on which some 300 to 400 station-years data are available. Among the new oats, Ora, produced by R. L. Thurman, of Arkansas, and the "Bingham" selections from Aberdeen, Idaho, produced by Frank Petr and Harland Stevens, in cooperation with the writer are notable examples among winter and spring oats, respectively. The histroy of the "Binghams" was included in OAT NEWSLETTER, Vol's. 10 and 11. The 17 strains were very similar in height, kernel characters, straw strength and yielding ability. Tested years ago by Matt Moore at St. Paul for stem and crown rust resistance, and for smut resistance by C. S. Holton of Pullman, they were found resistant to stem rust races 6 and 7A, resistant to all the more common races of smut and to have little if any crown rust resistance despite Bond, Victoria, Sante Fe, Green Russian and Hajira in their parental background.

The group have been grown primarily at Aberdeen, Idaho by Frank Petr and Harland Stevens of the U.S.D.A. In the period, 1960-64, inclusive 3,7,8,8, and 4 strains were included in the Northwest Area Irrigated Station Regional Nursery in the 5 respective years. The strains are so similar that the data from those grown have been averaged for the comparison shown:

| | Average data -- Aberdeen, Idaho -- 1960-1964, incl. | | | |
|---|---|---|---|---|
| | "Bingham" | Clinton | Bannock | Victory |
| Yield (bu.) | 170.6 | 144.2 | 164.2 | 157.3 |
| Test Wt. (lbs.) | 37.9 | 37.2 | 38.5 | 40.0 |
| Height (ins.) | 43.6 | 38.2 | 44.8 | 49.2 |
| Lodging (pct.) | 3.1 | 3.3 | 40.8 | 29.3 |

Clinton, the leading oat type in the North Central area, yielded 26.4 bushels and tested 0.7 pounds less, averaged 5.4 inches shorter yet lodged as much as the "Bingham" strains. Bannock, previously a leading variety on North West Irrigated Areas, yielded 6.4 bushels less, tested 0.6 pounds more, grew 1.2 inches taller and lodged 37.7 percent more on the average. Victory yielded less, tested more but lodged some 10 times as much.

A total of 13 "Bingham" strains were grown in comparison with Clintland 60, Clintland and Mo. 0-205. On a station in the North Central Area in a year when rusts were not a serious problem. In that nursery the "Bingham" oats, as a group, outyielded these three by 113.4, 128.0 and 144.6 percent, and lodged far less. The three lodged 294, 172 and 557 percent of the 13 "Bingham" strains, respectively. This was in spite of the fact that all are shorter-strawed than the "Bingham" oats.

Oat men are aware that in the last 5 years a decline of close to 14,000,000 acres has taken place in oats, under what was grown on the average in the previous 25 years. This drop prompts this "grandstand quarterback" to suggest oat breeders take a "second look" at those "Bingham" strains when considering parents for new crosses. This suggestion goes for both spring and winter oat areas. Meantime "prospecting" for stiff-strawed, dwarf-type oats similar to what Vogel has produced in wheats may well continue.

With regard to dwarf-normal oat crosses this writer many years ago heard of Vogel's efforts to produce dwarf wheats and started to cross dwarf-normal oats. Trelle was the dwarf used in most of the crosses. The project had the all-too-common defect of being a "small" one, that usually defeats a project aimed at an agronomic objective. After viewing the $F_5$ lines in rod-rows the late T. R. Stanton stated "It takes big oats to produce big yields." Nothing had evolved from this project to disprove his statement. The primary observations after the several years work may be stated.

1. Trelle's shortness results from short not necessarily fewer internodes.

2. It's "stiffness" stems from lowered "wind resistance" and does not seem to be genetic in nature.

3. Both "dwarfness and "panicle" type appeared dependent on multiple factors.

4. Possibly Trelle panicle was dominant as a smaller number of open-type panicles appeared, especially on short-strawed plants.

5. Trelle's objectionable panicle and floret characters (slender kernels, missing glumes, etc.) appeared to be linked characters.

After the study was dropped it was believed that some other dwarf might be a better parent than Trelle because of the above observations. Too it was considered that large, early generations were mandatory and the standing ability of both parents should be proved genetically before starting the project.

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III. CONTRIBUTIONS FROM OTHER COUNTRIES --

AUSTRALIA:

"New Oat Varieties from New South Wales" by P. M. Guerin, Richmond.

Two new varieties are being released by the New South Wales Department of Agriculture -- Bundy, a stiff-strawed high-yielding mid-season oat with tolerance to B.Y.D. (C.I. number - 8101)* and Mugga (C.I. number 8100)*, a very fast hardy winter oat to replace Algerian and possibly Acacia on the New England Tablelands.

I am preparing an article describing trials comparing wheat, oats, barley and rye over a number of years, both for grazing and for grain. From the results so far analyzed, oats appear to be the most productive cereal, here from the point of view of dry matter yields of grazing and of grain.

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* For parentage, see 1964 Oat Newsletter "C.I. Numbers Assigned".

"EMS for rust resistance" by J. L. McMullan, Dept. of Agriculture, Perth, Western Australia.

Avon oats is one of the varieties grown commerically in Western Australia and it is fully susceptible to race 2 of stem rust, the race of rust prevalent.

During the winter of 1965 an attempt was made to obtain a resistant mutant plant by soaking seeds in a 0.4% aqueous solution of EMS prior to sowing and rust testing the plants grown from them. In all a total of some 5,000 plants were tested using Gopher to establish the 4 type pustule for a susceptible variety. Plants were grown in glasshouse flats and the rust spores applied in talcum powder dusted over the moistened plants. The flats were then placed in a humidity cabinet for 24 hrs and then returned to the benches and rust readings taken 14 days later.

From the 5,000 plants treated two plants were obtained that appeared to have a 2 type pustule. These two plants were re-infected immediately and again gave 2 type pustules. The rust reaction of the progeny of these plants will be retested and it is hoped this apparent resistance will be confirmed.

The advantages of using such a technique for the production of varieties with resistance to new rust races are obvious.

CANADA:

R.I.H. McKenzie, J.W. Martens and G.J.Green, Canda Department of Agriculture, Winnipeg, Manitoba

Yields of oats were very good in Western Canada in 1965. A combination of a cool summer with plenty of rain over the whole area resulted in very heavy crops. Unfortunately this weather continued into the harvest season and the eventual yields were below what had been expected earlier. A total of 272 million bushels were produced on about 5 million acres. The average yield of 48 bushels per acre was well above average.

The development of backcross strains of Rodney with individual genes and combinations of genes for stem rust resistance has been partially completed. The following stocks are now available.

| | |
|---|---|
| Rodney$^5$ x Exeter | no genes |
| (Rodney$^5$ x Exeter) x (Rodney$^6$ x RL 2278) | gene A |
| Rodney | gene B |
| (Rodney$^5$ x Exeter) x (Rodney$^4$ x White Russian) | gene D |
| (Rodney$^5$ x Exeter) x (Rodney$^6$ x Jostrain) | gene E |
| (Rodney$^5$ x Exeter) x (Rodney$^6$ x CI 4023) | gene F |
| (Rodney$^5$ x Exeter) x (Rodney$^6$ x CI 7098) | genes A and D |
| Rodney$^6$ x RL 2278 | genes A and B |
| Rodney$^4$ x White Russian | genes B and D |
| Rodney$^6$ x Jostrain | genes B and E |
| Rodney$^6$ x CI 4023 | genes B and F |
| Rodney$^6$ x CI 7098 | genes A, B and D |
| (Rodney$^6$ x Jostrain) x (Rodney$^6$ x CI 4023) | genes B, E and F |

Stem and crown rust of oats developed too late in the season to cause significant losses in Western Canada in 1965. There was virtually no rust in the oat fields until the beginning of August so that most fields reached maturity with relatively light infections. However, late fields in the Red River Valley of Manitoba developed infections of up to 60% and these fields suffered considerable yield reductions. Race C10 (6AF) of stem rust, a race that can attack all commercial oat varieties grown in Canada, continued to increase in prevalence in Western Canada. It increased from 5% of all isolates identified from Manitoba and Saskatchewan in 1963 to 41% in 1964 to 50% in 1965. Serious losses could result from an early epidemic of this race in the immediate future. Races C3 (7A-12A) and C5 (6F) made up 26% and 22% respectively, of all isolates from Manitoba and Saskatchewan.

In Eastern Canada race C9 (6A-13A), also a race which can attack all commercial varieties, predominated with 68% of all isolates from this area. The bulk of the remaining isolates were identified as races C6 (8A-10A) and C8 (4A).

Ontario Agricultural College, Guelph, by E. Reinbergs

Dr. L. V. Edgington has joined the Botany Department, O.A.C., to conduct research in chemical disease control in cereals. Initial attempts have been made to seek rust and smut control through seed treatments with systemic chemicals.

Ottawa Research Station, Canada Department of Agriculture, C.E.F., Ottawa, by F. J. Zillinsky.

A record yield per acre was obtained from the 1965 Canadian oat crop. An estimated 420 million bushels were harvested from 80% of the seeded acreage at an average of 48 bushels per acre. More abundant rainfall in Western Canada and the lack of severe disease infection were the two most important factors contributing to the high production rate.

Results from the 1965 Co-operative Oat Tests on new varieties and strains were very encouraging, Stormont, the new lodging resistant oat released in 1965, compared favorably with standard varieties in both Eastern and Western Canada. Some outstanding seed increase yields were reported. Three entries from Western Canada, OT 173, OT 611 and OT 954 gave excellent yields in Eastern Canada. The development of improved varieties during the past few years has been most encouraging.

High Yielding Lines of Interspecific Origin (_A. strigosa_ x _A. sativa_) by V. D. Burrows, Ottawa Research Station, Canada Department of Agriculture, C.E.F., Ottawa.

Four oat lines (OA 123-1, OA 123-2, OA 123-3 and OA 123-4) possessing good agronomic characteristics have been obtained by the Plant Physiology Unit (V. Burrows) from a bulk population of interspecific oats (C.D.3820$^2$ x Abegweit and C.D.3820$^2$ x Victory) produced by F. Zillinsky, Head, Cereal Section, Research Station, Ottawa, Ontario. This bulk population, while not particularly high yielding itself, contains a tremendous amount of genetic diversity and is excellent material to use when evaluating selection techniques. The four lines referred to in this report were derived from plants selected for (a) good seed size, (b) ability of the seeds to sink when placed in water, (c) high relative growth rate as seedlings when grown under growth-room conditions, and (d) moderate-good lodging resistance when grown as seedlings (growth room) and as adult plants in the field. Some consideration was also given to the degree of rust infection in the field. These lines were selected as genetic stocks for our studies on the physiology of yield and lodging reaction and initially, there was no thought given to their potential value as candidates for varietal status.

In 1965, these lines were placed in the Ontario Project Group Screening Test (28 entries grown at 7 locations) for yield determinations. The average yields, and other agronomic data, of the standard varieties and the OA 123 lines are presented in the accompanying table.

| Entry | Yield lb./acre | Rank in test | Lodging (1-9) | 1000 kernel weight | % hull+ |
|---|---|---|---|---|---|
| Garry | 3819 | 6 | 3.0 | 33.2 | 26.6 |
| Rodney | 3676 | 14 | 4.4 | 33.3 | 25.6 |
| Russell | 3920 | 3 | 3.4 | 35.3 | 27.0 |
| Shield | 3263 | 25 | 2.7 | 32.1 | 22.7 |
| OA 123-1 | 4118 | 1 | 3.0 | 38.9 | 25.2 |
| OA 123-2 | 3882 | 4 | 4.0 | 33.0 | 29.4 |
| OA 123-3 | 3795 | 8 | 3.1 | 41.3 | 27.5 |
| OA 123-4 | 3742 | 11 | 2.8 | 38.6 | 29.2 |

+ Determined at two locations only.

These results encourage us to believe that Dr. Zillinsky's interspecific oat populations contain high yielding plant types and that some of the parameters and techniques that we are using as an outgrowth of our physiological investigations will be useful and efficient in finding these desirable plants.

A backcrossing program has been initiated to incorporate additional genes for stem and crown rust resistance, derived from other interspecific oat plants, into OA 123-1. We hope that someday the Ontario Project Group will be able to release a high yielding, disease resistant, variety of interspecific origin.

ENGLAND:

"Transference of winter-hardiness" by G. Jenkins
Plant Breeding Institute, Cambridge

The variety Maris Quest, recently released by the Institute, possesses high yielding ability and short stiff straw but has only moderate winter-hardiness. Winter oat varieties with extreme hardiness are rather primitive types with weak straw. An attempt is being made to transfer genes for winter hardiness to Maris Quest by back-crossing, using the hardy Yugoslav variety, Novosadsky II, as donor.

Preliminary results indicate that combining extreme winter hardiness with short stiff straw and high yielding ability is going to be difficult. Results are presented below for 13 $F_3$ lines selected as $F_2$ plants from the straight cross, Novosadsky II x Maris Quest, in artificial freezing tests. The $F_3$ lines were tested by means of Marshall's technique (Crop Sci. 5:83-86, 1965), clipped plants being subjected to -8°C for 16 hours.

Average survival of selections after freezing

| | Scored 10 days after freezing | | | Scored 15 days after freezing | |
|---|---|---|---|---|---|
| Selection | Percentage Survival | Stat.* sig. | Selection | Percentage Survival | Stat.* sig. |
| 31 | 98.0 | | 31 | 81.0 | |
| 28P | 95.0 | | Novosadsky II | 70.0 | |
| 28B | 90.0 | | 28P | 67.0 | |
| Novosadsky II | 88.0 | | 28L | 63.0 | |
| 28L | 88.0 | | 28N | 56.0 | |
| 28A | 87.0 | | 33 | 45.0 | |
| 33 | 86.0 | | 28B | 40.0 | |
| 29 | 85.6 | | 28A | 34.0 | |
| 32 | 80.0 | | 28C | 33.6 | |
| 28N | 80.0 | | 29 | 29.4 | |
| 28O | 79.0 | | 28O | 24.0 | |
| 28C | 77.0 | | 28E | 16.4 | |
| 28E | 74.0 | | 32 | 16.0 | |
| 30 | 69.4 | | Maris Quest | 7.4 | |
| Maris Quest | 65.0 | | 30 | 7.4 | |
| Feltwell | 31.0 | | Feltwell | 6.4 | |
| Blenda | 7.0 | | Blenda | 1.8 | |

*Grouped according to Duncan's Multiple Range Test at 5% level. Percentage transformed to angles for analysis.

The best selections, 31 and 28P, have a very prostrate juvenile habit and also very long weak straw. The selection which most closely resemble Maris Quest in field characters is Sel. 30. Work is now being concentrated on back-cross populations derived from Sel. 31 and Sel. 28P.

The results provide incidental information on the effect of delaying the date of scoring on the assessment of hardiness. Varieties of intermediate hardiness, like Feltwell, become indistinguishable from spring varieties but there is clear separation of extremely hardy lines.

## JAPAN:

Contribution from Hokkaido National Agricultural Experiment Station by T. Kumagai and S. Tabata

Heavy snow in February and March delayed oat seeding extremely. However, the favorable weather conditions after seeding prevailed especially in July and August. There was little precipitation during the ripening period, which formed a most important contributing factor to the oat production with better quality. The yield of Zenshin, our leading variety, was 31.6 kilogram per acre, 10% below the previous 11-years average.

The northern mosaic virus disease was more prevalent this year than last year. The screening test for resistant varieties showed that Albion Oat, Clinton and A. strigosa were higher, while Fulghum, Le Conte and Hokuyo (Japanese variety) were lower. Crown rust occurrence of 1965 was not severe as the previous year.

Winter hardiness is being tested for the purposes of searching for super-hardy oats. Conditions were generally unfavorable for winter oats. The meteorological feature, such as a considerable period of covered snow, probably formed the determining cause of severe winter-killing. Almost complete winter-killing occurred. It was found, however, that only four following varieties survived: R.6620, Lee, Cornell Sel. No. 1375 (C.I.5364), P.I. 177818. Freezing test and crossing work are being conducted among some winter oats, which have survived past cold winters at our station, to produce the hybrids with the superior degree of winter hardiness.

The breeding work is presently concentrated on the improvement of Zenshin to give the higher stiff-straw and the higher yield. Performance test, consisting of 11 lines of $F_6$, was tried. The results showed that three lines of these lines were superior to Zenshin, our check variety. The back-cross program to transfer lodging resistance, such as Milford and S. 172, to Zenshin has been conducted. Two hundred, thirty-seven lines were selected mainly on the basis of panicle characters. The most promising line is from the cross Honami x Zenshin ($F_9$), having more lodging resistance with high yielding and is being considered for possible release.

SWEDEN:

Sv original LINDA oats by A. Wiberg and G. Olsson, Swedish Seed Association, Svalof.

Sv original Linda is developed at the Swedish Seed Association, Svalov, Sweden. It is derived from a cross between the Finnish variety Eho and Blenda, presently one of the most commonly grown oat varieties in Sweden. The cross was made in 1947 and the first selection in 1949, followed by a second selection in 1957.

Linda is a white oats, very similar to Blenda in many respects as growth habit and time for maturity. Certain small morphological differences, however, make it possible to distinguish the two varieties. Thus the color of the leaves and panicles of Linda is somewhat lighter green than that of Blenda and more similar to the other parent variety Eho. Concerning the hairiness of the auricles and the lower parts of the leaf margins, Linda also is quite distinct from Blenda but similar to Eho.

The average grain yield and the yield of pure kernels for Linda compared to the two most common oat varieties in Sweden are given below. The data are based on more than 400 trials with each of the two control varieties.

| | Relative grain yield | Relative yield of pure kernels |
|---|---|---|
| Blenda | 100,0 | 100,0 |
| Linda | 103,9 | 103,0 |
| Sun II | 100,0 | 100,0 |
| Linda | 100,6 | 101,3 |

As shown above Linda yields 4% more than Blenda or about the same as Sun II. The grain quality, however, is not so good as for Blenda but higher than for Sun II. This fact changes the relative yield of pure kernels in favour of Linda compared to the latter control variety.

Linda has a grain of medium size. The test weight is somewhat lower than for both Blenda and Sun II and the 1000-grain weight about equal to Blenda but little higher than for Sun II. The time of maturity is the same as for Blenda or 2 days earlier than for Sun II. The straw stiffness of Linda is good as shown below. In 62 trials at the Swedish Seed Association the following results were obtained.

| | | |
|---|---|---|
| Blenda | 7,3 | (The scale runs from 0 to 10, where 10 means no lodging) |
| Linda | 7,8 | |
| Sun II | 8,1 | |

In field trials Linda has been less damaged by the frit fly than both Blenda and Sun II.

Linda will be marketed in 1966. The variety is intended to replace Blenda, where that is grown. Although it seems to be well adapted to many different conditions, the ability to compete with other varieties as Sun II will probably be highest in the eastern part of Sweden, where the climate is somewhat dryer than further west.

## YUGOSLAVIA:

### The Oats Investigation Program at Plant Breeding Institute in Kragujevac, Yugoslavia by A. Popovic[1] and B. Kostic[2]

The oat varieties that are most widely grown in Yugoslavia usually are of the spring habit. In 1963, both spring and winter oats covered the area of about 315.000 ha. Spring oat is successfully grown in the mountainous regions. Because of its short vegetation it is very good adapted to the conditions of this area. On the other hand, winter oat is restricted to a relatively very small area and mostly further to the south.

The increase of yield is of very importance in the national economy. The low yielding home varieties and populations are largely replaced by high productive varieties from Holland (Condor, Marne), Germany (Flemingstreue)

[1]Plant Breeder and [2]Plant Pathologist, Plant Breeding Institute, Kragujevac

and some other countries, especially in the latest year. This has been favorized by the farmers themselves, who are keenly interested in higher income.

A realization of the Program for oats improvement and breeding set up by the Plant Breeding Institute at Kragujevac is under way.

In our testtrials are included the hybrids from the crosses between some American varieties, such as Victoria, Anthony, Kanota, and some Yugoslav varieties. American varieties are preferred because of their short straw, resistance to lodging and pretty earliness, while Yugoslav varieties are more suitable to the soil and climatic conditions of this area.

In 1966 field test the F-5 generation lines are being investigated. For this purpose the pedigree method is in use.

Some lines of winter oats are also being tested. They are derivatives from the crosses between Yugoslav variety "Novosadski 2" and American varieties Wintok, Red Rustproof, DuBois and Winter oat.

The lines of the combination "Wintok x Novosadski 2" were found to be of the highest degree of winter hardiness, but they are of not enough resistance to lodging. More perspective combination it seems to be between Novosadski 2 and Winter oat, because of better straw and quality. In order to be released and spread successfully some other characters of the lines should be evaluated, too.

From the new lines is asked to possess the same or even higher yielding capacity than that in imported varieties. For that reason the yield potential of the parental varieties should be investigated more carefully.

For intensvie agriculture the lodging resistance is of great concern, so that stiff straw varieties are in any case desired.

Disease resistance is also one of the very important characters, since the varieties now in cultivation are very susceptible to almost any oat disease.

In the fields of southeastern Yugoslavia oat is suffering mostly of rusts (Crown rust and Stem rust) and smuts (Black loose smut and Covered smut). The degree of attack is greatly influenced by the environmental conditions and by the varieties themselves, which are almost very susceptible.

The investigation led by the junior author has revealed the race spectrum of Puccinia coronata avenae and Puccinia graminis avenae.

Twelve physiologic races of crown rust fungus were found to be present in southeastern part of Yugoslavia: 201, 206, 211, 262, 263, 264, 268, 276, 292, 304, 230 and 294. The most prevalent in 1962 were races 211, 276 and 263, while the leading position in this respect in 1963 was overtaken by the races 276 and 230. Rhamnus sp. is widespread which rusts abundantly almost every year, making the area more rich in physiologic races.

The number of physiologic races in stem rust fungus was remarkably lower than in crown rust. In a period of 1961-1963, six physiologic races of that fungus were determined: 1, 2, 6, 7, 8 and 11, the second and third ones in the order being the most prevalent.

In 1964 Test Trial 39 spring and 36 winter varieties of oats were inoculated with the suspension of urediospores of crown rust races (211, 262, 263, 264) in the Rust nursery. In a high epidemic the lowest coefficient of infection was found in Saia, whose value reached 55.

The same entries were inoculated with races 2 and 6 of stem rust both in greenhouse and in rust nursery. A great number of them has shown a very susceptibility in seedling as well as in adult stage. Varieties Saia, New Garry, Ag. 313 and Ag. 354 are possessing a satisfactory resistance.

In 1965 thanks to Dr. Loegering's courtesy, U.S.D.A., a collection of 1965 InternationlNursery was inoculated with stem and crown rusts at Kragujevac. Since data of these readings were forwarded to Dr. Loegering, they won't be commented here. But it is worthwhile to mention that some of the varieties have shown some degree of resistance especially to crown rust.

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## IV. CONTRIBUTIONS FROM THE UNITED STATES: USDA AND STATES

<u>ARKANSAS</u> by R. L. Thurman (Fayetteville) --

Approximately 1400 certified acres of Ora were produced. The growers fields averaged above 90 bushels per acre.

Much of the fall acreage of oats was damaged due to insufficient soil moisture following planting. Fall growth was above normal where soil moisture was not a limiting factor because temperatures have been above normal.

Crown rust was present in the western part of the state in the fall. A comparison of greenhouse tests and field reactions of several breeding lines indicated that races 290 and 326 were present.

<u>FLORIDA</u> by Dale Sechler and W. H. Chapman (Quincy) --

Florida's oat acreage was up 15% in 1965 according to the Crop Reporting Service. As usual most of the emphasis was on grazing with only about 20% of the acreage being harvested for grain. The reported yield was 38 bu/acre.

Crown rust was rampant in 1965 with races 213, 216, 264, 305, 325, 326 and 327 being identified on material sent to Dr. M. D. Simons. Rust started building up by mid-December. Florad rusted badly for the first time. Suregrain rusted but produced some grain while Floriland, Moregrain, and Radar 2 rusted out completely in the Quincy area. No rust was observed on Florida 500 and little on Ora. <u>Helminthosporium avenae</u> also was very severe, killing the more susceptible material. No good sources of resistance to <u>H. avenae</u> has been observed in hexaploid oats at Quincy although definite levels of susceptibility are noted. Soil-borne mosaic virus symptoms were quite prevalent in early seeded susceptible material but were rare in oats seeded after mid-December.

Florida 500, released in 1965, produced good yields in four increase fields across North Florida. No rust was observed in the variety but

H. avenae caused considerable leaf spotting. Over 8,000 bu. of seed were distributed by the Florida Foundation Seed Producers Association.

Conditions were good for early seeding of oats in the fall of 1965 although extended dry periods did occur in late Oct. and early Nov. Stand loss was less serious than usual due to better moisture distribution and fewer high temperatures. Favorable weather contributed to good growth for grazing up to mid-January. Crown rust started building up in late December and could result in rust being as severe in 1966 as in 1965.

IDAHO by Frank C. Petr and Ralph M. Hayes, USDA and University of Idaho, Aberdeen --

Adequate moisture and cool temperatures in the early part of the season gave Idaho's 1965 oat crop a good start. Heading dates were delayed somewhat and most varieties grew taller than normal. Excellent yields were reported in irrigated areas where most of the oat acreage is grown. Yields were also excellent in the non-irrigated areas of northern Idaho.

The oat yield nursery at Aberdeen including the Northwestern regional entries averaged over 200 bushels per acre. Russell, Zanster, C.I. 8263 and C.I. 2874 were the four highest yielding varieties. Orbit yielded well in all areas of the state. AuSable was outstanding in test weight and produced a better than average yield.

Oat research at the Aberdeen experiment station is concentrated on improvement of yield, straw strength and quality. The quality work consists mainly of improving kernel weight, test weight and protein content. Some selections with excellent kernel weight have been developed, but none seem to have adequate yield potential. Divergent hybridization and recurrent selection are in progress to overcome this difficulty.

The active world collection of oats was grown at Aberdeen in 1965 for seed increase and observation, in cooperation with Dr. J. C. Craddock. Emergence and yields of all varieties were very good. Very little lodging occurred, which aided in the agronomic evaluation of this large group of varieties and types.

The University of Idaho grew a collection of wild species of oats at Aberdeen as part of a federal contract to increase seed for research purposes. Stands and yields were very satisfactory for this type of material. Research is in progress to overcome the problems of dormancy, shattering and seed processing.

Bingham (C.I. 7588) is being released jointly by the United States Department of Agriculture and the University of Idaho. Foundation seed is being distributed to Idaho certified seed growers in 1966. Description and parentage of this variety are included in the section on new varieties.

ILLINOIS by C. M. Brown, H. Jedlinski, W. D. Pardee, W. O. Scott and M. C. Shurtleff (Urbana) --

For most Illinois oat growers, 1965 was a good oat year -- despite a late spring that held up oat planting over most of the state. The Illinois Cooperative Crop Reporting Board reports that our 1965 state average oat yield was 57 bushels per acre, which ties the all-time average yield set in 1963. We have had reports of high yields from individual fields. There were many yields in the 80- to 90-bushel range, and some over 100 bushels. In general, grain was high in both test weight and quality. Yields were high in spite of the late planting season. The weather stayed cool through May and early June, favoring strong tillering. Moisture was adequate in most areas during grain formation, and diseases were few. Crown rust came too late to cause much damage and sporadic occurrence of halo blight was of no consequence. Some losses were suffered due to barley yellow dwarf in Southern Illinois. Oat smut was on the increase throughout the state. This increase was consistent with the trend established over the past four years.

The acreage of oats harvested in Illinois continued its decline with only 887,000 acres harvested for grain in 1965. The late planting season was partially responsible for the record low acreage.

Newton remained the most popular variety for the sixth consecutive year but its percent of the total acreage has shown a slight decline in the past two years. Garland showed a major increase in acreage while Goodfield and Nemaha decreased some in popularity. The percentage acreage of several varieties in Illinois in recent years is as follows:

| | Percent of Total Acreage Planted | | | | |
|---|---|---|---|---|---|
| Variety | 1961 | 1962 | 1963 | 1964 | 1965 |
| Clintland | 18 | 12 | 10 | 7 | 7 |
| Clintland 60 | 2 | 6 | 6 | 8 | 6 |
| Clintland 64 | - | - | - | - | 1 |
| Garland | - | - | - | 3 | 13 |
| Goodfield | 4 | 10 | 9 | 12 | 8 |
| Minhafer | 9 | 5 | 5 | 3 | 2 |
| Nemaha | 10 | 11 | 10 | 8 | 6 |
| Newton | 42 | 41 | 42 | 39 | 37 |
| Putnam 61 | - | - | - | 2 | 2 |
| Shield | 1 | 2 | 2 | 3 | 2 |
| Others | 13 | 13 | 16 | 15 | 16 |

<u>INDIANA</u> by F. L. Patterson, J. F. Schafer, R. M. Caldwell, L. E. Compton, J. J. Roberts, Henry Shands and B. C. Cliffor (Breeding, Pathology and Genetics), R. K. Stivers and O. W. Luetkemeier (Varietal testing), M. L. Swearingin and W. Reiss (Extension) (LaFayette) --

## The 1965 season

A wet spring delayed oat seeding until late April, a month after optimum. A cooler than average May and June were favorable for oat production. The average yield was estimated at 52 bu/A for 336,000 acres. The decline in acreage from 348,000 in 1964 was less than anticipated from the rate of decline in recent years. Losses from diseases were low.

## Oat varieties

Clintland type oats continue to predominate in Indiana in 1965. The variety survey of the Statistical Reporting Service and the certified seed production figures are:

| Variety | First season of Production | 1965 acreage % | Certified seed acres |
|---|---|---|---|
| Clintland 60 | 1960 | 29.4 | 68 |
| Clintland | 1955 | 17.2 | - |
| Newton | 1957 | 13.4 | 164 |
| Goodfield (Wis.) | 1960 | 11.1 | 130 |
| Clinton 59 | 1949 | 10.9 | - |
| Putnam 61 | 1962 | 7.3 | 127 |
| Putnam | 1958 | 2.7 | - |
| Garland (Wis.) | 1964 | - | 57 |
| Tippecanoe | 1966 | - | 1672 |
| Clintland 64 | 1965 | - | 1736 |

The varieties certified are those recommended in Indiana. Norline and Dubois are the recommended winter oat varieties.

New releases

About 1000 bushels of Tyler, C.I. 7679, and 1500 bushels of Clintford, C.I. 7463, are being distributed to Indiana Certified Seed Growers in February 1966. Foundation seed of Tyler was shared with Illinois, Iowa, Minnesota, South Dakota and Wisconsin and breeders seed of Clintford was shared with Illinois, Iowa, Minnesota, Ohio and South Dakota.

The 2 varieties were described in the 1964 Oat Newsletter. No additional releases are anticipated at this time.

Research and Breeding

Summaries of research and breeding are presented as abstracts of the National Oat Conference in this newsletter. They include:

1) Spread of crown rust in relation to resistance levels and composition of resistant host varieties.
2) Linkage relations in the A-D-F region.
3) Increasing oat yields under high fertility with shorter, stiffer-strawed varieties.
4) Relation of nitrogen and population levels to oat yields.
5) Are hybrid oats the answer?

Other research and breeding activities are indicated in the publications listed.

KANSAS by E. G. Heyne and James Lofgren (Manhattan)--

Although the oat acreage continues to decline, the yield per acre has been maintained at a high level for Kansas. This may reflect a change in attitude toward the oat crop by the remaining growers, giving more attention to cultural practices. Most farmers recognize that better seedbed preparation, use of fertilizers, and timely seeding will improve yields.

Winter killing was severe in Kansas and the nursery plantings of winter oats at Hutchinson and Manhattan were completely killed. There was some survival of oat lines in the nursery tests in southeastern Kansas at Mound Valley. Wintok has had a few plants' survival to no killing at all during the winter at Manhattan 13 out of the last 16 years. No plants survived in 1965. Farmers in southeastern Kansas like winter oats for fall pasture. With a little more increase in hardiness, winter oats would increase in acreage in that area.

Spring oat work in Kansas is now primarily testing of lines in the uniform nurseries. The late varieties performed well in 1965. On the average, varieties later than Mo. 0-205 are considered to be too late. CI 7674, an Andrew backcross derived line, has a good record but is probably later than desired. However, CI 7674 will be given further tests in 1966. CI 7698, another Andrew derived line from complex parentage, is as early or earlier than Andrew and it has a good yield record, a large kernel, and an apparent wide adaptation. It will be tested extensively in Kansas in 1966.

The Kansas station approved Neal oats for growing in Kansas. Neal was released in Nebraska in 1963. It is shorter, earlier, and has stiffer straw than Andrew or Mo. 0-205. It equals or exceeds these two varieties in most other economic characters in Kansas. Other recommended varieties in Kansas are Andrew, Mo. 0-205, Minhafer, and Tonka.

Franklin A. Coffman, long-time oat research worker with the U. S. Department of Agriculture was honored by Kansas State University when he was recognized for Distinguished Service to Agriculture during the annual station conference, January 31-February 2, 1966. Mr. Coffman received his B.S. degree from Kansas State College in 1914 and his M.S. in 1922. His thesis problem was on the variability in Burt oats. The oat varieties released by the Kansas station alone or in cooperation with other states all had some attention from Mr. Coffman, either in making the cross or in growing some of the segregating generations. These varieties were Fulton, Osage, Neosho, Cherokee, and Nemaha. Mr. Coffman, however, has had his hand in the development of many more oat varieties than this - an estimated 100 varieties during his lifetime work with oats. Kansas State University is proud to have such an alumnus.

<u>MICHIGAN</u> by J. E. Grafius and A. H. Ellingboe (East Lansing)

The 1965 season was again characterized by drought in June and early July. This makes the third year in a row for June droughts. The reserve moisture in the soil in the spring was such that excellent yields were obtained in most areas of this state. Maximum yields exceeded 150 bushels at East Lansing.

Diseases were not important but real concern has developed over the Cereal Leaf Beetle. This insect has not been contained in its original area of introduction (Southwestern Michigan) despite rather heroic measures by the Bureau of Quarantine.

The control program has developed into a well integrated effort covering quarantine, control by spraying, biological control, and breeding. State, Federal and University personnel are cooperating in this effort. Satisfactory control measures with low dosages of malthione have been worked out and insect predators are being worked with, but the breeding for resistance will apparently be more difficult, at least in oats. No very high type of resistance has been found. Techniques for laboratory testing have been worked out by Dr. John Schillinger (USDA). Dr. David Smith (USDA) is starting to survey the species collections. Most of the world collection has been surveyed.

Last year a preliminary list of tolerant varieties was given. We must now acknowledge the fact that these varieties did not stand up this year. The reason for lack of consistency has been traced to accidental drift of malthione from commercial spraying over a mile from the plots. The spray caused a temporary halt in feeding which allowed certain varieties to escape.

When more definite information on resistance has been obtained, the information will be made available. It is planned to make single backcrosses between adapted varieties for the area and resistant varieties. This material will be selected for resistance to the beetle and then released to interested states.

No new varieties will be released in Michigan in 1966.

Resistance to potentially dangerous races of rust is being incorporated into Coachman and AuSable via the backcross.

MINNESOTA by M. B. Moore, Roger Kleese, Allen Heagle (St. Paul)

Buckthorn plot:

When the buckthorn plot was established at St. Paul in 1952, it was with some misgivings that possibly all lines of oats from whatever source might be or become susceptible, but it was also with the idea that if this should turn out to be the case it should be known. With the accumulation of experience and with increasing confidence in the usefulness of a buckthorn plot as a tool in the selection of crown rust resistance, the plot was enlarged in 1965 to about an acre.

Of the commerical varieties and of available breeding lines in the uniform performance nurseries and rust nurseries, more of them are rated susceptible in the buckthorn plot than in field nurseries and many are more susceptible. However, there are many selections from the Minnesota breeding program and from other widely different sources that appear to be resistant in different degrees. Many, but not all of these lines have maintained about the same level of resistance for from 3 to 5 years. Resistance of the various lines ranges from HR with trace to 10% severity, through R, MR, MS, S and VS with 80-100% severity on the S and VS lines. Some of the more resistant lines may have a few S or MS pustules and it is probable that these represent virulent but not prevalent races for those lines. It seems probable that some pathogenic potentials of the rust may be missing entirely or present in undetectable amounts.

In addition to the above, lines have been found which appear to rust more slowly and to a lesser degree than fully susceptible lines. Some other lines although heavily infected seem to induce early teliospore formation thus limiting the amount of uredial inoculum that can be produced. It is hoped that these two characters may be generally effective against many races of rust.

Of the commercial varieties Portage has consistently rusted a little more slowly than the others, and Rodney and Minhafer seem to have a little of this characteristic.

Personnel Items:

Roger Kleese will leave the project July 1, and will be replaced at that time by a full time breeder not yet designated.

In addition, Olin Smith, who comes to us from Oklahoma, will serve as full time breeder while pursuing the Ph.D.

Allen Heagle has a Ph.D. thesis problem on the effectiveness of partial resistance in reducing the spread of crown rust.

Mengistu Hulluka, while working toward an M.S. degree, is evaluating new sources of resistance to stem rust.

MISSISSIPPI by Paul G. Rothman, (Delta Branch Experiment Station, Stoneville)

Oat acreage in the State remains in a downward cyclic move. The 79 thousand acres harvest in 1965 was the lowest since 1937 and a decrease of 20 percent below the figure for 1964. Yields were also below last year's. Average yield per acre in 1965 was 40 bushels. Unusually dry periods through the growing season and at heading of the oat crop limited yields.

Several periods of extremely cold weather with temperatures plunging below the freezing point, following warm spells, caused extensive foliage damage. One cold spell in late March badly froze-back the early varieties already in the jointing stage reducing yields of all these varieties.

Soilborne oat mosaic and barley yellow dwarf virus caused extensive damage to the oat nursery. The 1965 Uniform Oat Rust Nursery is fall seeded at Stoneville and was heavily infected with SBOM, table 1.

Thirty-four winter oat varieties widely grown in the Southeastern States were evaluated for their responses to BYDV when infected in the fall and in the spring under controlled inoculation techniques with a single strain of BYDV. Yield means of these varieties in this study are presented in table 2.

Table 1. Entries in the 1965 Uniform Oat Rust Nuersey with given scores for symptom expression of SBOM at Stoneville, 1965. Score 1 to 10 increasing in severity.

| Entry No. | Score | Entry No. | Score | Entry No. | Score | Entry No. | Score |
|---|---|---|---|---|---|---|---|
| 1 | 7 | 16 | 2 | 31 | 4 | 46 | 8 |
| 2 | 5 | 17 | 2 | 32 | 5 | 47 | 9 |
| 3 | 3 | 18 | 2 | 33 | 5 | 48 | 9 |
| 4 | 3 | 19 | 9 | 34 | 3 | 49 | 9 |
| 5 | 5 | 20 | 5 | 35 | 6 | 50 | 7 |
| 6 | 9 | 21 | 5 | 36 | 2 | 51 | 9 |
| 7 | 5 | 22 | 8 | 37 | - | 52 | 9 |
| 8 | 4 | 23 | 8 | 38 | 7 | 53 | 9 |
| 9 | 7 | 24 | 2 | 39 | 7 | 54 | 9 |
| 10 | 2 | 25 | 7 | 40 | 5 | 55 | 6 |
| 11 | 7 | 26 | 9 | 41 | 5 | 56 | 3 |
| 12 | 7 | 27 | 3 | 42 | 7 | 57 | 5 |
| 13 | 2 | 28 | 5 | 43 | 7 | 58 | 8 |
| 14 | 5 | 29 | 3 | 44 | 5 | 59 | 8 |
| 15 | 5 | 30 | 5 | 45 | 8 | 60 | 5 |

Table 2. Ranking of 34 winter oat varieties based on mean hill grain weight for treatments in a controlled inoculation study of fall vs. spring infestation with BYDV.

| Variety | Yield gms. | Variety | Yield gms. | Variety | Yield gms. |
|---|---|---|---|---|---|
| Ora | 90.5 | Roanoke | 48.7 | Alamo x | 29.7 |
| Moregrain | 75.5 | Sumter | 48.7 | Nortex 107 | 28.8 |
| Cimarron | 70.5 | Carolee | 43.7 | Blount | 24.7 |
| Fairfax | 69.2 | Suregrain | 40.0 | Delta Red 88 | 21.2 |
| Forkedeer | 67.0 | Alber | 39.3 | Faggart | 19.5 |
| Lee | 63.2 | Arkwin | 38.5 | Alamo | 19.2 |
| Arlington | 62.8 | Bronco | 38.0 | Victorgrain | 17.0 |
| Jefferson | 62.0 | Floriland | 33.0 | New Nortex | 15.0 |
| Delair | 60.7 | Dubois | 32.5 | Radar 2 | 14.7 |
| Norline | 59.7 | Radar 1 | 32.0 | Camellia | 13.3 |
| Midsouth | 57.7 | Nortex | 31.8 | | |
| Mustang | 50.5 | Fulwood | 31.5 | | |

L.S.D. at 5% level 30.3 gms.

NEBRASKA by J. W. Schmidt (Lincoln)

Oats

Dennis D. Warnes, who had been associated with the oat and barley project since 1963, has been assigned to Supervise the Agronomy operations at the Mead Field Laboratory. Dr. J. W. Schmidt will now have the responsibility for the oats and barley project in addition to his wheat breeding program.

The oat acreage continued to drop to 722,000 acres the lowest acreage harvested sine 1884. Growing conditions were very good for the oats that was planted and this resulted in the highest average oat yield on record in Nebraska.

A new oat variety Santee (CI 7454) was released to certified growers in 1965 and will still have a rather limited seed supply for 1966. Santee continues to perform well in state yield tests.

NEW YORK by Neal F. Jensen (Ithaca)

Production -

1965 production in New York was 512,000 harvested acres, 55.0 bushels per acre and 28,160,000 bushels total production.

Varieties -

The principal variety is Garry; others grown in 1965 were Russell, Niagara, Oneida, Tioga, Rodney and miscellaneous others. Orbit will enter the picture in 1966.

Certification -

A thesis study of oat seed usage in New York by John Fendick disclosed that 56.6 percent of the total acreage is sown with Certified Seed. It is believed that New York ranks high in the use of Certified Seed by farmers.

Orbit -

Foundation Seed production in 1965 was about 150 acres with average yields of 80 bushels per acre. It is estimated that 1965 Certified Seed production will make available enough Orbit to plant 100,000 acres in New York in the spring of 1966. Foundation Seed Acreage for 1966 will be substantially larger than 1965 to provide for increased demand.

Winter Oats -

The winter oat breeding project has been placed on a standby basis with just enough being done on it to keep in touch with developments. Composites from the Cornell project are being shared with other cooperators through Dr. Marshall. Long-range, we think the crop has potential but we need the extra time right now for pressing problems in wheat and winter barley.

NORTH CAROLINA by C. F. Murphy, T. T. Hebert, D. M. Kline (USDA), M. F. Newton and M. Holton (Raleigh) -

In spite of dry weather during the latter part of the growing season, the state average oat yield was a record 43 bu/A. Acreages declined again, however, from 144,000 to 135,000 A.

Possible Source of BYDV Resistance --

A heavy natural infection of barley yellow dwarf virus developed in a head row nursery last year. Carolee checks were found to be relatively free of symptoms and several $F_2$ populations involving Carolee parentage were also observed to have apparently resistant segregates. Non-parasitic leaf spotting on mature plants appeared to be closely associated with BYDV infection. Four populations were classified for this leaf spotting, with the following results:

| Cross | Res./Sus. ratio |
|---|---|
| Carolee x Goodfield | 173:178 |
| Moregrain x Goodfield | 27:266 |
| Carolee x Bambu | 171:225 |
| Moregrain x Bambu | 3:300 |

These populations are being studied further, but our current thinking is that Carolee may at least offer a high level of tolerance to our most serious oat disease.

OHIO by Dale A. Ray (Columbus) --

1965 Season and Production -

Wet, cold weather in the early spring delayed spring oat seeding and contributed to the decline in oat acreage. Timely occurrence of rainfall and moderate temperatures in the mid-summer months promoted good growth and the maturity of the crop proceeded for harvest only about one week behind the average schedule of recent seasons. Oat diseases were light and the yield and quality of the harvested crop were good.

The acreage of oats harvested in Ohio for 1965 was 4 percent less than for 1964 and was one of the lowest oat acreages on record for the state. Oat production in 1965 was estimated at 35.4 million bushels and although representing only a slight decline from the previous year was nearly 30 percent below the average production of the crop in the state for the previous 5-year period. The estimated average yield of 56.0 bushels per acre was essentially the same figure as for the average yield of the crop over the previous 5 years.

Following successive years with abandonment of fields with severe winterkilling of stands, winter oats acreage in the state essentially has been eliminated.

Oats Varieties -

Clintland 60 is the leading variety in Ohio oats acreage, with Garland gaining in popularity particularly in northern Ohio. Brave has been outstanding for both yield and test weight in the recent state-wide oat yield trials and has been added in recommendation.

Spring oat varieties recommended in Ohio for 1966 are Brave, Clintland 60, Dodge, Garland and Goodfield for grain purposes and Rodney for oat silage or green chop.

Oat Investigations -

The head-row progenies from early-maturing, stiff-strawed selections obtained from earlier crosses of several varieties with sources of resistance to crown and stem rust were bulked for preliminary yield testing.

Cytological and genetic studies with several inter-species crosses were initiated. Study on intra- and inter-row systems of seeding for oat seed increase were conducted by Gary Jolliff for his M.S. thesis.

OKLAHOMA by C. L. Moore, A. M. Schlehuber, B. R. Jackson, H. C. Young, Jr. and E. E. Saari (Stillwater) --

Production and Breeding -

Conditions in Oklahoma were favorable for oat production in 1965 as no major hazards occurred during the growing season. Although grain yield per acre was one of the highest on record, production was 7 percent lower than 1964 because of another decrease in harvested acreage. The 227,000 harvested acres probably represents about 60 percent of the total seeded acreage since much of the crop is utilized for forage.

An attempt to improve straw strength and seed quality in winter oats through winter x spring crosses (Cimarron x Tonka and Stanton Strain 1 sel:C.I. 6902 x Tonka) has yielded several promising strains. Eight of these that appear quite productive and exhibit good straw strength and test weight have been entered in the Uniform Oat Winterhardiness Nursery.

Heritability scores have been obtained in three segregating populations of winter oats. Observations were made on $F_3$ plant rows at normal seeding rates for several characters. Values for number of kernels per panicle and kernel weight were moderately high (53 and 44, respectively) while those for number of panicles per unit area and grain yield were somewhat lower (33 and 22, respectively). These estimates may be biased since genotype x environment interactions were not removed from the genetic variances.

The inheritance of a "physiological disease" of the variety Cimarron is not clearly understood. The disease (Cimarron blight) which occurs in approximately the eastern 1/3 of Oklahoma has been reported to be controlled by more than one gene with incomplete dominance for resistance. In 1965 $F_3$ plant rows from two populations of winter oat crosses where one parent was Cimarron segregated 3:1 for susceptibility: resistance. Lines were classed susceptible when the disease was presented in the row was it as not possible to determine the percentage of the plants within each row infested. These data would suggest monogenic inheritance with susceptibility dominant. However, greenhouse observations of $F_1$ hybrids of Cimarron crosses do not indicate that susceptibility is dominant. Further study of the inheritance of this disease is planned.

Diseases -

During the 1964-1965 crop year 276 winter habit oat selections from the world collection were grown at Prairie View and Beeville, Texas, in cooperation with Dr. I. M. Atkins, to make observations on "tolerance," "field resistance", or "epidemic resistance" to crown resistance. At these locations, the selections were subjected to a heavy crown rust epidemic during the winter and early spring. In April, observations were made on: maturity; crown rust severity of both uredia and telia; average uredial pustule size; a rough estimate of a relative yield potential at that time; and on evidence of any specific resistance.

Many of the selections had been killed by rust by April, and many others did not head. Those selections that showed some promise of a respectable yield and yet exhibited no evidence of specific resistance, fell mostly into two groups; either derivatives of Lee x Victoria crosses, or derivatives of Anderson or crosses with it. Correlations of the various factors measured have not yet been made.

A total of 107 lines were saved and were planted at the same locations again in 1965. Crosses between certain of the Lee x Victoria and Anderson derivatives are being made for further study.

PENNSYLVANIA by H. G. Marshall (University Park) --

Winter Oats -

Winter oat production in Pennsylvania was severely reduced for the fourth consecutive year by winterkilling and droughty conditions. The interest in the crop continued to decline and only 59 acres were grown in the state for certified seed production during 1965. Farmers who have had several winter oat failures because of severe winterkilling are not likely to try the crop again unless varieties with significantly better winter hardiness are developed.

The winter oat breeding nurseries near University Park were completely winterkilled, but differential survival occurred at the Southeastern Field Research Laboratory near Landisville, Pa. Yields at the latter location were severely reduced by droughty conditions during the spring and summer, and the recommended varieties Norline and Dubois only averaged 49.0 and 39.7 bushels per acre, respectively, in yield tests. Yields were also reduced by a lack of moisture in a winter oat forage experiment, and neither yields nor composition of forage was influenced by top dressing in the spring with nitrogen. Norline averaged only 8.0 tons of forage per acre when the grain was in the milk stage. These tests will be continued for at least two more years to determine the forage potential of winter oats in southeastern Pennsylvania.

Mr. Fred Muehlbauer completed his M.S. degree during 1965, and is continuing as a 3/4 time research assistant while working toward the Ph.D. degree in plant breeding and genetics.

SOUTH DAKOTA by R. S. Albrechtsen and V. D. Pederson (Brookings)

1965 Season and Production -

1965 was a good year for oat production in most of South Dakota. A wet, cold spring delayed seeding in most of the state but continued favorable temperatures and moisture supply made possible the production of a good crop.

Oats were produced on an estimated 2,460,000 acres in 1965 and yielded an average of 48 bushels per acre. The acreage was equal to that in 1964, only slightly below the previous 5-year average and yield per acre was considerably higher than either previous period, resulting in a bumper crop.

Crop losses due to disease were small. Crown rust and stem rust were generally present but became established too late to do extensive damage to varieties possessing a reasonable degree of resistance.

Seed Increase and Distribution -

The South Dakota Foundation Seed Stock Division participated in the increase of Tyler and Clintford in 1965. Seed of these varieties will be released to certified growers in 1966. Certified seed of Brave, Clintland 64, Tippecanoe and Santee was produced in 1965.

Personnel Item -

Mr. Yung Yen Yeh is completing the requirements for the M.S. degree in Plant Breeding. His work is being supported by a grant from the Quaker Oat Company. His research is concerned with the influence of fertility level and seeding rate upon the components of seed yield and related characteristics.

SOUTH DAKOTA by Stanley G. Jensen (Northern Grain Insects Research Laboratory, Brookings)

Some Effects of Barley Yellow Dwarf Virus on the Physiology of Clintland 60 Oats -

Studies have been conducted on the effects of BYDV on the highly susceptible Clintland 60 variety of oats. Seedlings were inoculated with a severe strain of BYDV as the second leaf emerged. They were then held in a growth chamber at 60°F. with 14 hours of light while disease symptoms developed. At intervals after inoculation, leaves from the diseased plant and from comparable uninoculated controls were analyzed for photosynthetic rate, respiration rate, dry weight, and chlorophyll content. The disease produced changes in all of these parameters. The results of one experiment of this type are shown in Table 1.

Table 1.

| Days After Inoculation | | CHLOROPHYLL mg.chlorophyll/ gm.fresh wt | | DRY WT. mg. dry wt/ gm.fresh wt | | PHOTOSYN. $ulCO_2$/min/ gm.fresh wt | | RESPIRATION $ulCO_2$/min/ gm.fresh wt | |
|---|---|---|---|---|---|---|---|---|---|
| | | H* | D | H | D | H | D | H | D |
| Leaf 2 | 7 | 2.02 | 1.58 | 150.8 | 181.0 | 67.2 | 32.7 | 6.1 | 6.5 |
| | 9 | 2.03 | 1.25 | 149.0 | 233.4 | 67.2 | 19.9 | 5.0 | 5.6 |
| | 10 | 1.88 | 0.83 | 146.0 | 248.4 | 64.5 | 18.8 | 5.8 | 5.6 |
| | 11 | 1.60 | 0.68 | 148.8 | 271.4 | 64.8 | 9.2 | 3.6 | 5.5 |
| | 13 | 1.79 | 0.43 | 137.2 | 256.8 | 57.8 | 10.7 | 3.7 | 5.8 |
| Leaf 3 | 14 | 1.79 | 1.13 | 157.2 | 231.4 | 51.3 | 27.7 | 6.0 | 6.4 |
| | 16 | 2.12 | 1.01 | 147.4 | 232.4 | 53.9 | 31.1 | 5.3 | 6.2 |
| | 18 | 2.13 | 1.04 | 150.8 | 225.6 | 48.5 | 32.8 | 4.6 | 5.6 |
| | 21 | 1.86 | 0.67 | 196.0 | 254.6 | 53.2 | 28.3 | 4.6 | 4.2 |
| Leaf 5 | 37 | 1.53 | 1.00 | 327.4 | 339.8 | 66.6 | 27.2 | 4.1 | 5.7 |
| | 39 | 1.35 | 0.43 | 314.0 | 353.8 | 54.0 | 14.8 | 5.4 | 5.2 |

*H = Uninoculated controls, D = BYDV infected.

The rate of photosynthesis is severely affected by BYDV. In the second leaf, the photosynthetic rate is reduced by 50% one week after inoculation and 90% one week later. In the third and fourth leaves, photosynthesis is reduced consistently about 50%. Chlorophyll content is also sharply reduced by virus infection. On the other hand, dry weight is consistently increased and approaches 200% of normal in the second leaf as it begins to become senscence. Respiration is consistently above normal in the infected leaves when expressed in terms of fresh weight but well below normal on a dry weight basis.

TEXAS by I. M. Atkins (USDA and TAES) and Milton McDaniel (College Station) J. H. Gardenhire (Denton), K. B. Porter (Bushland), K. A. Lahr (Chillicothe), Lucas Reyes (Beeville), M. J. Norris (McGregor), U. D. Havelka (Temple), and R. A. Kilpatrick (USDA, College Station).

The Texas seeded acreage of oats was estimated at 1,899,000 acres. Use of the crop exclusively for forage plus spring drought and damage by rust combined to reduce the harvested crop to 895,000 acres. Average yield was 25 bushels per acre for a total production of 22,375,000 bushels.

The major problem facing breeders was that of additional shifts in the rust races so that by the end of the season of 1965, old "demon" rust again has the upper hand. During the spring season, race 326 was predominant so most of our material, developed for resistance to race 264, rusted severely. Several hundred strains, selected for resistance to race 264 at Puerto Rico last spring, were increased at Aberdeen, Idaho during the summer for more extensive testing. Two strains from this breeding program are seeded in 2 acre increase blocks.

Likewise, after spending 3 years transferring stem rust resistance to Suregrain, that variety was susceptible to prevalent crown rust races. In spite of this fact, we are increasing 2 Suregrain type stem rust resistant strains. Some unexpected and still unexplained resistance appeared in certain Denton strains when subjected to the severe epidemic at Beeville.

Preliminary results of identification of crown rust races in Texas for 1965, as collected by Dr. Kilpatrick and identified by Dr. M. D. Simons, show that the predominat races are 326, 213 and 216, while races 264, 276 and the 290 group have not increased as feared. Races of stem rust identified by Dr. B. J. Roberts are largely 6F and 6AF, neither of which were prevalent before 1963. Again we have no commercial varieties with adequate resistance.

Weather conditions were unfavorable for increase of new varieties. Foundation seed of the new hardy variety, Norwin C.I. 8018, was destroyed by hail. Most fields of Houston were seriously damaged by excessive rain and storms in Central Texas. The Arkansas variety Ora appears well adapted in Texas. During 1965 it was more resistant to crown rust than Moregrain and Suregrain, but this fall it too has rusted.

Transfer of greenbug resistance from Russian 77 to locally adapted varieties is making some progress, but behavior of progeny of some crosses appears abnormal.

Considerable difficulty has been experienced in developing stable lines of cytoplasmic male sterile oats from the cross of *Avena barbata* x *Avena byzantina*. Some lines grown at Denton appear of promise and were crossed to New Nortex and other adapted varieties.

Additional collections of feral oats were made from Texas, northern Mexico and from the Mexico City area. From among strains tested in Puerto Rico last year, two strains with a high degree of adult plant resistance to race 6A were discovered. Hardiness tests of 200 strains at Bushland, Texas and at Stillwater and Woodward, Oklahoma prove that some of these lines are as hardy as the check varieties Bronco and Fulwin.

As a result of early fall rains followed by very mild weather, oats have provided record amounts of forage in the fall of 1965. Growers in north Texas, apprehensive about low temperature damage to the heavy growth, have offered free pasture to livestock people. J. H. Gardenhire obtained over 775 pounds of dry matter per acre from Alamo-X by December 16.

## TEXAS by J. P. Craigmiles, Rice-Pasture Research & Extension Center (Beaumont)

### Oats for Winter Grazing in the Texas Gulf Coast Prairie -

A two-crop system of agriculture - rice and pasture - is used in the Gulf Coast area of Texas. Beef cattle is virtually the only alternative enterprise to rice, with livestock accounting for one-fourth of the total value of farm products sold. Forage is at a premium during the cold, damp winter, and generally cattle lose weight during this period. To alleviate this problem, a series of studies, using oats along with other winter annuals, were initiated in 1964. This is a brief preliminary report on these studies.

Twenty varieties of small grains - 9 oats, 3 wheats, 5 barleys, and 3 ryes - were planted in clipping trials October 22. Oats made the highest yields at the earlier clipping date although wheat made the greatest total production (2853 lbs. dry matter per acre compared to 2714 for oats). The two highest yielding oats for forage were Suregrain (3022 pounds) and Ora (3004 pounds). Barley averaged 2527 pounds, and rye, 2390 pounds of dry matter per acre.

In an oat, ryegrass, and clover compatability study, using Moregrain oats, Gulf ryegrass, Abon Persian clover, Michelianum clover, ball clover and Berseem clover, highest forage yields were obtained from the combination of oats, ryegrass and Abon clover with 2743 pounds of dry matter per acre, followed by oats and berseem clover with 2606 pounds. With every species and combination of species tested, the addition of ryegrass increased total forage production.

In a third study, a temporary pasture mixture, consisting of two bushels of Moregrain oats, 20 pounds of Gulf ryegrass and 10 pounds of Abon Persian clover were seeded October 22. Three rates of nitrogen - 30, 60, and 120 pounds per acre - were applied at four different times, (1) all at seeding, (2) half at seeding and half in winter, (3) half at seeding and half in spring, and (4) one-third at seeding, one-third in winter, and one-third in spring. First year's results indicate that as the increment of nitrogen is increased, forage production increases up to 60 pounds of N. A yield increase was not obtained when 120 pounds of nitrogen was applied. At this high rate, Abon clover was eliminated by the aggressiveness of the ryegrass and winter killing was severe in the oats. Splitting the rate of nitrogen, applying half at planting and half in winter, gave the highest forage yields but not sifnificantly more than applying all the N at planting.

Probably the limiting factor in the widespread use of oats for grazing in this area is the inability of oats to withstand "wet feet" on these low, poorly drained rice lands.

<u>WISCONSIN</u> by H. L. Shands and R. A. Forsberg

Wisconsin State Oat Yields and Variety Performance -

The 1965 season in Wisconsin was irregular in rainfall, yet the high average yield of 61 bushels per acre equalled the previous alltime high yield of 1958. Actually yields were higher than indicated; but the average was reduced because of very poor harvest conditions aggravated by rain in parts of northern Wisconsin where grain was very productive. The Wisconsin Statistical Reporting Service estimated an average of 65 bushels per acre September 1, 1965.

Early in 1965 the same Service conducted a special oat variety survey to learn the percent of acres sown in 1964 to the major oat varieties. Four varieties made up 58% of the acreage. This survey showed that Beedee was sown on 25 percent of Wisconsin's 2,149,000 acres, or down from 34 percent in 1961. Beedee was followed by Garry which had 13 percent, while Garland and Rodney had 10 percent. Ajax, Portage, Dodge, Goodfield, Sauk and Clintland (60) had 8, 6, 5, 4, 4, and 3 percent, respectively. Beedee may have been above 34 percent in 1962. Most of these varieties are losing acreage to Lodi.

Wisconsin oat acreage dropped below 2,000,000 in 1965 for the lowest acreage in many years. Acreage may drop still further. Other small grains dropped in acreage in Wisconsin in 1965.

The usual seed growers' reports were not available for 1965. They may be reinstated in 1966. Of the varieties certified in Wisconsin recently, a large grower reduced his number to Beedee, Garland and Lodi.

Crown and Stem Rust -

Stem rust was scattered over the state in many fields in Wisconsin. One field of Beedee had nearly all plants attacked with about 15 percent severity late in the growing season. Only slight yield damage was done; but trouble seems to be gathering. Crown rust was not vicious in 1965 except for the fact that varieties like Garland, Lodi and Garry showed large pustules near buckthorn bushes. Portage, Trispernia and P.I. 174544 resistances are still promising. The P.I. resistance is usually in combination with other types.

Miscellaneous -

Two selections of current interest are X643-75, C.I.7978, and X957-2, C.I.8040. The latter was free of crown rust in Rio Grande do Sul, Brazil.

Clintland 64 was produced for certification in Wisconsin for the first time in 1965. Tippecanoe will be produced by seed growers for certification in 1966.

Dr. I. Nishiyama joined the Wisconsin group April 20, 1965, and has continued various cytogenetical studies of his own material as well as Wisconsin-produced amphiploids of interspecific origin. The amphiploids contain combinations of A. barbata and A. sativa, and a derived tetraploid (C.I.7232) and A. sativa. Hybrids between Dr. Nishiyama's octaploids and common oats have been studied.

Personnel items -

D. C. Hess and J. J. Pavek received Ph.D. degrees in June. Dr. Hess is now with Paymaster Seed Farms at Plainview, Texas, and Dr. Pavek is in USDA Potato Investigation at Aberdeen, Idaho. D. M. Wesenberg is working on oat grain quality and oat breeding. P. A. Salm, J. J. Schreck and Paul Sun are other small grain assistants. Very probably Dr. Nishiyama will complete his second year in Wisconsin, April 1967.

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# V. NEW OAT VARIETIES

## a) Alphabetical List:

| Name | C.I. No. | Origin |
|---|---|---|
| Bingham | 7588 | USDA and Idaho |
| Dawn | 8029 | North Dakota |
| Harmon | 7989 | Ottawa and Indian Head (Canada) |
| Honami | ---- | Hokkaido, Japan |
| Linda | ---- | Svalof, Sweden |
| Maris Quest | ---- | Cambridge, England |
| Taylor | 8269 | McCurdy (Iowa) |
| Wyndmere | 7552 | North Dakota |

## b) Description:

### Bingham:

Bingham (C.I. 7588) is a white-kernelled spring type oat derived from a multiple cross of Cleo x Garry x [(Bonda x Hajira-Joanette x Santa Fe) x Mo. 0-205] made by F. A. Coffman. It is scheduled for joint release by the United States Department of Agriculture and the University of Idaho in 1966. The outstanding attributes of Bingham are high yield potential and excellent straw strength. It is resistant to race 8 of stem rust and to Victoria blight. In Idaho, it is best adapted to irrigated areas.

### Dawn:

The North Dakota Agricultural Experiment Station plans to release and increase C.I. 8029 oats to provide seed for farmer distribution in the spring of 1967. This selection is from the cross (Ajax x Ranson) x (Roxton-R.L. 1276) x (Ajax-R.L. 1276). The Ajax x Ransom cross was made in 1955 which became identified as C.I. 7553. The subsequent cross was made in 1959. C.I. 8029 has been tested two years in the Uniform Midseason Oat Nurseries and at several locations in North Dakota.

C.I. 8029 is very early but comparable in yield to other early maturing varieties in North Dakota and in the North Central States. Its strength of straw is superior to Brave. It excells in stem rust and crown rust resistance. Because of its earliness and superior rust resistance it is expected to be best adapted in southeastern North Dakota and adjacent areas. Because of its earliness C.I. 8029 should be well adapted as a nurse crop for underseeded forage crops.

C.I. 8029 is being released because of its protection against stem and crown rust and because of its earliness. We have suggested the name Dawn because of the extreme earliness of C.I. 8029.

Harmon:

Harmon was developed from a cross between Rodney and O.T. 604, a weak-strawed but high yielding, stem rust resistant strain from the cross [(Victoria x (Hajira x Banner)) x Roxton] x Beacon. The cross was made in Ottawa in 1956, but all the propagation and selection work was conducted at Indian Head, Saskatchewan, with the main emphasis on rust resistance.

Harmon was tested in the Western Co-operative Oat Test for four years and outyielded Rodney at all but one of the 17 test locations in Western Canada. It was licensed in the spring of 1965 on the recommendation of the Associate Committee of Plant Breeding. Approximately 10,000 bushels of seed will be available in the spring of 1966.

Harmon is very similar to Rodney in most characteristics. It has a similar large plump kernel, moderately tall and moderately strong straw, and is fairly late in maturity. Harmon has the same stem rust resistance as Garry and Russell (genes A and B) and is resistant to almost all races of loose and covered smut. However, it is moderately susceptible to crown rust.

Honami:

Oat breeding in Hokkaido lays stress on the introduction of dominant factors for high standing ability. The present breeding program was planned with the aim of improving the defects of "Victory No. 1", which has been distributed as a leading variety throughout Hokkaido.

"Honami" was registered as a recommended variety of oats for most of Hokkaido in 1959. This variety was developed at the Hokkaido Agricultural Experiment Station, Kotoni, from a cross of "Kuromi" x "Victory No. 1".

"Honami" is shorter in culm length, longer in panicle length, greater in number of spikelets and smaller in weight per 1000 kernels than "Victory No. 1". The form of panicle is spreading, density of kernels is greater, color of hull is yellowish white, size of grain is intermediate and extent of awing is designated as slight. The time of maturity of this variety is about two or three days later than that of "Victory No. 1". The variety is susceptible to crown rust and leaf-spot diseases. The lodging resistance of this variety is much higher than that of "Victory No. 1".

As for yield, "Honami" is consistently higher than "Victory No. 1" in most areas and equals "Zenshin" in some areas. This variety shows high adaptability to small applications of fertilizer and later seeding, as well as to heavy applications and dense planting. "Honami" is well adapted to the greater part of Hokkaido. The variety may produce well even in areas with low soil fertility levels. "Honami" can be replaced mostly by "Victory No. 1" and partly by "Zenshin", a high yielding variety.

Linda:

(see under SWEDEN -- Section III, page 87)

Maris Quest:

This new winter oat variety was selected from the cross Blenda x S. 172 at the Plant Breeding Institute, Cambridge, England. Seed of Maris Quest was released in the autumn of 1965 and the variety has been included in the Recommended List of the National Institute of Agricultural Botany for 1966. An application for a grant of Breeder's Rights in respect of Maris Quest has been made to the Plant Variety Rights Office.

Maris Quest combines very high yield with resistance to stem eelworm (*Ditylenchus dipsaci*) and short, stiff straw. Tested in official trials from 1960 to 1964, this variety consistently and markedly outyielded the control variety, Powys. Maris Quest ripens on average about three days later than Powys. It is slightly less winter hardy than Peniarth, being similar in this respect to Padarn. It is moderately susceptible to powdery mildew (*Erysiphe graminis* f. sp. *avenae*). The white grain is plump and has a high 1000 corn weight for its length.

Maris Quest exhibits vigorous vegetative growth with a characteristically erect habit. It is recommended as a general purpose, high yielding winter oat with stem eelworm resistance and particularly as a replacement for S. 172 where resistance to lodging and shortness of straw are required.

Taylor: (M2608 C.I. 8269)

M2608 was developed from a cross of Bond-Rainbow-Hajira-Joanette-Landhafer-Victoria-Hajira-Banner-Colo. It was developed and distributed by W. O. McCurdy & Sons, Fremont, Iowa.

M2608 is a medium height, with medium plump white kernels, high yield, high test weight, good standing variety.

Wyndmere:

The North Dakota Agricultural Experiment Station plans to release and increase C.I. 7552 oats to provide seed for farm distribution in the spring of 1967. This selection is from an Ajax x Ransom cross made in 1955. It was entered in the Uniform Regional Nurseries from 1960-1964. Comparative North Dakota tests were made at several locations.

Because of its earliness, stem rust and crown rust resistance, C.I. 7552 appears best adapted to southeastern North Dakota. The earliness and strong straw of C.I. 7552 should make it well suited as a companion crop for underseeded forage crops.

C.I. 7552 is being released because of earliness, good yield, stem rust and crown rust protection, white kernel and good test weight.

We are suggesting the name Wyndmere for C.I. 7552. Wyndmere is the name of a town in Richland County, North Dakota, and a center of oat production for grain and certified seed oats.

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## VI. C.I. NUMBERS ASSIGNED TO OATS IN 1965:

a) USDA Small Grain Collections by J. C. Craddock, USDA, Beltsville, Maryland

During 1965 the New Crops Research Branch, CR, ARS, USDA assigned Plant Introduction (P.I.) numbers to 682 samples of *Avena* from seven countries. Oat breeders may be interested to learn that 630 introductions of *Avena sterilis* were received from Israel. However, seed of these introductions will not be available until after they have been grown in detention and a seed increase obtained. The Cereal Investigation (C.I.) numbers were assigned to 102 oats obtained from oat workers in 20 states and three foreign countries. These additions were assigned Cereal Investigation numbers 8163 through 8264.

Starting January 1, 1966 the assigning of C.I. numbers to oats and the distribution of these entries will be in accord with the policy proposed by Dr. L. A. Tatum in the 1964 Oat Newsletter.

> "... Our proposal is that material not be given C.I. numbers and included in the World Collections until it can be made available to any or all interested breeders. In other words, nothing except released varieties would move automatically into the Collections and we would not maintain germ plasm with restrictions on distribution. Unnamed material having special merit could be added to the Collection by appropriate "release" procedures. The proposed procedure might eliminate a major source of elite germ plasm in the Collections for it is unlikely that all originators would bother to make positive action to have it included. The partially off set this we would ask uniform test coordinators to systematically inquire of the originating station whether an entry being dropped from the test should be moved into the Collection ..."

In the future C.I. numbers will not be assigned to an oat entry until the originating breeder and/or station agrees in writing that these will become the property of the U.S.D.A. Small Grain Collection and will be open stock available for unrestricted distribution.

As soon as possible I will circulate a list of the oats that have been assigned C.I. Numbers in the past eight years. At this time the plant breeder and/or originating agency will have the option of withdrawing such selections from the U.S.D.A. Oat Collection. I am requesting this so that as of a specified date (as yet not designated) everything in the U.S.D.A. Small Grain Collections will be open stock.

b) World Oat Gene Bank by J. C. Craddock

The World Gene Bank for cereal breeders would appreciate receiving seed from early generation oat crosses that are surplus to your needs. The success of this project depends upon regular contributions of seed from as many breeders as possible. To date there has not been a sufficient quantity of oat seed received to warrant making a bulk. Bulks of wheat and barley have been made and seed of these are made available upon request.

c) Cereal Investigation (C.I.) Numbers Assigned to Oats During 1965

| C.I. Number | Name or Designation | Pedigree | Origin and/or Source |
|---|---|---|---|
| 8163 | Ark. Sel 3-74-H3 | Lee x Vtra 2x Fwn 3x Bda 4x Lh 5x Mg | Arkansas |
| 8164 | Ark. Sel 3-74-H4 | Lee x Vtra 2x Fwn 3x Bda 4x Lh 5x Mg | Arkansas |
| 8165 | Ark. Sel 3-74-H14 | Lee x Vtra 2x Fwn 3x Bda 4x Lh 5x Mg | Arkansas |
| 8166 | Ill. 62-1453 | Putnam 2x Goodfield 2x Minhafer | Illinois |
| 8167 | Ill. 62-1456 | Ptn 3x Gdf 2x CI 5254 x Mhf | Illinois |
| 8168 | Ill. 62-3834 | PI 174544 x Minhafer | Illinois |
| 8169 | Iowa C237-77 | Clintland x Garry-5 | Iowa |
| 8170 | STORMONT | Shield 2x Garry x Klein, Cross 5243 | Canada |
| 8171 | I.H. 5880-3-3-1 | Vtra 2x Hi x Bnr 3x Rxt 4x Bcn x Rdy | Canada |
| 8172 | R.L. 2796 | Garry x Rex | Canada |
| 8173 | Ill. 62-1535 | Minrus 2x Morota x Bond 3x Clintland 60 | Illinois |
| 8174 | Iowa C177-45-1 | Vtra 2x Hj x Bnr 3x Vtry x Hj 4x Rxt 5x Cld | Iowa |
| 8175 | N.Y. 5279a1B-2B-333 | Alo 4x Gy-5 3x Gdw 2x Vtra x Rb | New York |
| 8176 | N.Y. 5279B-3B-59 | Alo 4x Gy-5 3x Gdw 2x Vtra x Rb | New York |
| 8177 | N.Y. 5524B-2B-10 | Gy-5 3x Sdy 4x Gdw 2x Vtra x Rb | New York |
| 8178 | S.D. RROII-B-60-2-149 | Ctn 6x Lh 2x R.L. 2120 3x Gy | S. Dakota |
| 8179 | DORVAL | | Canada |
| 8180 | ACTON | | Canada |
| 8181 | ANGUS | | Canada |
| 8182 | VIGOR | | Canada |
| 8183 | Stw 616577 | Wintok (early sel) x LeConte | Oklahoma |
| 8184 | Stw 616577 | Wintok (early sel) x LeConte | Oklahoma |
| 8185 | Tenn. 59-19 | Fg x Fkd 2x Tenn (early sel 77) x LeConte | Tennessee |
| 8186 | Tenn. 60-32 | Lh x Fkd 2x Fg$^6$ x Lec 3x Tenn (early sel 25) 2x $^6$Fg x Lec | Tennessee |
| 8187 | Mo. 05071 | Wintok x Forkedeer | Missouri |
| 8188 | Ky. 63-8061 | White Winter S-172 x Dubois | Kentucky |
| 8189 | Ky. 64-10720 | White Winter S-172 x Dubois | Kentucky |
| 8190 | Ky. 64-10968 | White Winter S-172 x Dubois | Kentucky |
| 8191 | Ky. 64-10991 | White Winter S-172 x Dubois | Kentucky |
| 8192 | Ky. 64-11014 | White Winter S-172 x Dubois | Kentucky |
| 8193 | Ky. 64-11032 | White Winter S-172 x Dubois | Kentucky |

| C.I. Number | Name or Designation | Pedigree | Origin and/or Source |
|---|---|---|---|
| 8194 | Ky. 64-11112 | White Winter S-172 x Dubois | Kentucky |
| 8195 | Ky. 64-11158 | White Winter S-172 x Dubois | Kentucky |
| 8196 | Ky. 64-11207 | Dubois$^2$ x White Winter S-172 | Kentucky |
| 8197 | Ky. 64-11424 | Dubois$^2$ x White Winter S-172 | Kentucky |
| 8198 | Ky. 64-11674 | Dubois$^2$ x White Winter S-172 | Kentucky |
| 8199 | Ky. 64-11705 | Dubois$^2$ x White Winter S-172 | Kentucky |
| 8200 | Ky. 64-11922 | Dubois$^2$ x White Winter S-172 | Kentucky |
| 8201 | Ky. 63-1110 | Wintok x Stanton 2x White Winter S-172 | Kentucky |
| 8202 | Ky. 64-6483 | Wintok x Stanton 2x White Winter S-172 | Kentucky |
| 8203 | Ky. 64-8710 | Tvl 3x RR 2x Vtra x Rld 4x Fwn x Wtk 5x WWt S-172 | Kentucky |
| 8204 | Ky. 64-9083 | Fwn x Wtk 4x Tvl 3x RR 2x Vtra x Rld 5x WWt S-172 | Kentucky |
| 8205 | Ky. 64-9504 | Traveler Sel 1 x Bicknell 2x WWt S-172 | Kentucky |
| 8206 | Ky. 64-9545 | Traveler Sel 1 x Bicknell 2x WWt S-172 | Kentucky |
| 8207 | Ky. 64-9675 | Traveler Sel 1 x Bicknell 2x WWt S-172 | Kentucky |
| 8208 | Ky. 64-9631 | Traveler Sel 1 x Bicknell 2x WWt S-172 | Kentucky |
| 8209 | Ky. 64-7685 | Fulwin x Wintok 2x White Winter S-172 | Kentucky |
| 8210 | Pa. 63-16-7764 | HC 2x Wtk x HC | Pennsylvania |
| 8211 | Pa. 63-16-8507 | Sel 5346 x Lec 2x Bl 3x CI 7317 x CI 8126 | Pennsylvania |
| 8212 | Pa. 63-16-6149 | HC x Dub 2x Mlf x Nys | Pennsylvania |
| 8213 | Pa. 63-16-2131 | Ballard x Dubois | Pennsylvania |
| 8214 | Pa. 64-8-397 | Mlf 2x Wtk x HC 3x Lec x Dub 2x Nys | Pennsylvania |
| 8215 | Pa. 64-8-384 | Sel 4833 x Lec 2x Nys 3x Wtk x Aa 676 | Pennsylvania |
| 8216 | Pa. 63-16-6154 | HC x Dub 2x Mlf x Nys | Pennsylvania |
| 8217 | Pa. 63-16-5527 | Wtk 2x Wtk Sel x HC | Pennsylvania |
| 8218 | Delta 910-3 | Delair 2x *A. abyssinica* x *A. sterilis* | Mississippi |
| 8219 | Delta 447-4 | Tama x Col 6x Hj x Jt 4x Lee x Vtra 2x Fwn 3x Bond x Ath 5x Lh 7x S.E.S. 52-R47 | Mississippi |
| 8220 | Ark. 3-68-551-529 | Lee x Vtra 2x Fwn 3x Bda 4x Lh 5x Mg | Arkansas |
| 8221 | N.C. 267 | Carolee x Moregrain | N. Carolina |
| 8222 | N.C. 2469 | Carolee x Fulgrain | N. Carolina |
| 8223 | N.C. 1972 | Fg 5x Cmr 4x Hj x Jt 3x Aln 2x Ctn x SF | N. Carolina |
| 8224 | Va. 62-4-263 | Ballard Sel. x Fulwood | Virginia |
| 8225 | Va. 62-4-28 | Victorgrain 48-93 x Cimarron | Virginia |

| Number | Name or Designation | Pedigree | Origin and/or Source |
|---|---|---|---|
| 8226 | Fla. 63-378 | Flr 5x Fg-3 x Sg 4x Vg$^{2}$2x Bond x Flg 3x Sg | Florida |
| 8227 | Fla. 62-671 | Arl 3x Wtk 2x Ctn $^{2}$x SF 4x Flr | Florida |
| 8228 | Delta 61140-5 | Delair x Milford | Mississippi |
| 8229 | Delta 267-7RL | Dlr 4x Lee x Vtra 2x Fwn 3x Ctn x SF 6x Hj x Jt 4x Lee x Vtra 2x Fwn 3x Bond x Ath 5x Lh | Mississippi |
| 8230 | Coker 66-20 | Sg 3x Coker 62-30 2x Hj x Jt | S. Carolina |
| 8231 | Delta 59120-10-11 | LMHJA 6x Hj x Jt 4x Lee x Vtra 2x Fwn 3x Bond x Ath 5x Lh | Mississippi |
| 8232 | SORBO | | Sweden |
| 8233 | Delta 907-3 | Flr 2x Delair x Milford | Mississippi |
| 8234 | Fla. 64-377 | Flr 5x Fg-3 x Sg 4x Vg $^{2}$2x Bond x Flg 3x Sg | Florida |
| 8235 | Minn. 65-B1106-1113 | LMHJ x$^{2}$ And 2x Rdy 3x BM x Ab 101 | Minnesota |
| 8236 | Minn. 65-B2165-2172 | LMHJ x$^{2}$ And 2x Rdy 3x BM x Ab 101 | Minnesota |
| 8237 | Minn. 65-B2361-2370 | Rdy 2x SF x Ctn 3x BM x Ab 101 | Minnesota |
| 8238 | Minn. 65-B2414-2426 | Cleo x I Gy 4x Bda 2x Hj x Jt 3x SF x Mo. 0-205 5x BM x Ab 101 6x Cleo x I Gy 4x Bda 2x Hj x Jt 3x SF x Mo. 0-205 5x Hj x Bnr | Minnesota |
| 8239 | Minn. 65-B2494-2507 | BM x Ab 101 3x LMHJ $^{2}$x And 2x$^{4}$ Rdy | Minnesota |
| 8240 | N.D. 65-25 | Ajax x Ran 3x Rdy 2x SF x$^{3}$ Ctn | N. Dakota |
| 8241 | Purdue 5243RB1-8-2-1-1 | Rxt x R.L. 1276 2x Ajax x R.L. 2176 3x Ctn 59 $^{7}$x Lh | Indiana |
| 8242 | Purdue 5817A3-12P-2-2-1 | Vtra 2x Hj x Bnr 3x Vtry x Hj 4x Rxt 5x Ctn $^{2}$x Ark. 674 8x Ctn 59 x Lh $^{4}$6x Ctn 2x Bne x Car 5x Vtra 2x Hj x Bnr 3x Vtry x Hj 4x Rxt 7x Cld 3x Ctn $^{2}$x Ark. 674 2x Mlf | Indiana |
| 8243 | Purdue 5821A6-4-4-2 | Dg 5x Ctn 59 $^{7}$x Lh $^{4}$3x Ctn 2x Bne x Car 4x Cld 3x Ctn 2x Ark. 674 2x Mlf | Indiana |
| 8244 | Purdue 5930RG2-3P-2P-2 | Mlf 2x Ctn $^{2}$x Ark. 674 3x Cld 60 2x Cld $^{3}$x Abda 4x Btn $^{5}$x Lh 2x R.L. 2105 3x Btn $^{7}$x Lh 5x Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn x Bond 2x P.I. 174544-3 4x Ctn 59 $^{7}$x Lh 2x Mlf | Indiana |

| Number | Name or Designation | Pedigree | Origin and/or Source |
|---|---|---|---|
| 8245 | Purdue 5957RC4-5-3-1 | Mlf 2x Ctn $^{2}$x Ark. 674 3x Cld 60 2x Cld $^{3}$x Abda 4x Btn $^{5}$x Lh 2x R.L. 2105 3x Btn $^{7}$x Lh 5x Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn x Bond 2x P.I. 174544-3 4x Ctn 59 7x Lh 2x Mlf | Indiana |
| 8246 | Purdue 5989B2-2-3 | Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn 59 $^{7}$x Lh 5x Cld 3x Ctn $^{2}$x Ark. 674 2x Mlf 4x Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn x Bond 2x P.I. 174544-3 | Indiana |
| 8247 | Purdue 5989B2-4-1 | Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn 59 x Lh 5x Cld 3x Ctn x Ark. 674 2x Mlf 4x Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn x Bond 2x P.I. 174544-3 | Indiana |
| 8248 | TITUS | | Sweden |
| 8249 | Purdue 6138A1-2 | Rxt x R.L. 1276 2x Ajax x R.L. 1276 3x Ctn 59 $^{7}$x Lh 4x P.I. 185783 | Indiana |
| 8250 | KYTO (64SP68) | | Yugoslavia |
| 8251 | KYTO (64SP71) | | Yugoslavia |
| 8252 | Minn. 65-B1254-1258 | LMHJ $^{2}$x And 2x Rdy 3x BM x Ab 101 4x Rdy | Minnesota |
| 8253 | Minn. 65-B1296-1298 | LMHJ x$^{2}$ And 2x Rdy 3x BM x Ab 101 4x Rdy | Minnesota |
| 8254 | Minn. 65-B1317-1319 | BM x Ab 101 2x LMHJA x Cld 3x Rdy | Minnesota |
| 8255 | Minn. 65-B1352-1358 | LMHJA x Cld 2x BM x Ab 101 | Minnesota |
| 8256 | Minn. 65-B1615-1618 | LMHJA x Cld 2x BM x Ab 101 | Minnesota |
| 8257 | Minn. 65-B1989-1997 | LMHJ x$^{2}$ And 2x Rdy 3x BM x Ab 101 | Minnesota |
| 8258 | Minn. 65-B2207-2210 | Rdy 2x SF x Ctn 3x BM x Ab 101 | Minnesota |
| 8259 | Tex. 63C3868-4-2 | SF x$^{2}$ Ctn 3x Sac 2x Hj x Jt 4x NN x Lh 5x BM x Ab 101 | Texas |
| 8260 | Tex. 64C4153-3 | SF x$^{2}$ Ctn 3x Sac 2x Hj x Jt 4x NN x Lh 5x BM x Ab 101 | Texas |
| 8261 | Tex. 65C306 | Abda x$^{5}$ Suregrain | Texas |
| 8262 | Tex. 65C308 | Abda x$^{5}$ Suregrain | Texas |
| 8263 | N.Y. 5271aB-2B-51 | Craig x Alamo | New York |
| 8264 | MONSTER | | U.S.D.A. |

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##########

VIII. MAILING LIST:

Dr. K. Aastveit, Norges Lantbrukshogskoles, Akervekstforsok, Vollebekk, NORWAY
Ewart Aberg, Plant Husbandry Dept., Agricultural College of Sweden, Uppsala 7, SWEDEN
Juan Acevedo, Casilla 58-D, Temuco, CHILE
Rulon Albrectsen, Agronomy Dept., South Dakota State University, Brookings, S. Dakota 57007
Deane C. Arny, Dept. of Plant Path., Univ. of Wisconsin, Madison, Wisconsin 53706
Turhan Atay, Plant Improvement Station, P.K. 17, Eskisehir, TURKEY
I. M. Atkins, Soil and Crop Sciences, Texas A. and M. University, College Station, Texas
R. E. Atkins, Agronomy Dept., Iowa State Univ., Ames, Iowa 50010
E. P. Baker, Dept. of Agriculture, Univ. of Sydney, Sydney, N.S.W., AUSTRALIA
H. R. Ballantyne, Experimental Farm, P.O. Box 1240, Melfort, Saskatchewan, CANADA
B. Beard, Southwestern Irrigation Field Station, P.O. Box 1339, Brawley, California
Anders Bengtsson, Dept. Plant Husbandry, Agricultural College of Sweden, Uppsala 7, SWEDEN
Ivan Bespalow, Agway Seed Research, 26 Central Street, West Springfield, Massachusetts 01089
Wayne Bever, Dept. of Plant Path., Univ. of Illinois, Urbana, Illinois
Biblioteca, Centro Nal. Investigaciones Agricolas "Tibaitata", Apartado Nal. 34-13, Bogota, D.E., COLOMBIA, S.A.
La Biblioteca, Sta. Cataline Estocion Experimental, I.N.I.A.P., Apartado No. 2600, Quito, ECUADOR, S.A.
M. J. Bitzer, Agronomy Department, Purdue University, LaFayette, Indiana 47907
P. T. Blood, Agronomy Dept., Univ. of New Hampshire, Durham, New Hampshire
G. H. Boewe, Illinois Natural History Survey, Urbana, Illinois 61801
S. Bokde, Agronomy Division, Indian Agr. Res. Institute, New Delhi 12, INDIA
F. E. Bolton, Agronomy Dept., Oklahoma State Univ., Stillwater, Oklahoma 74075
O. T. Bonnet, Agronomy Dept., Univ. of Illinois, Urbana, Illinois
Carl Borgeson, Agronomy Seedstocks Bldg., Univ. of Minn., St. Paul, Minnesota 55101
D. H. Bowman, Delta Branch Exp. Station, Stonevill, Mississippi
W. J. R. Boyd, Inst. Agriculture, Univ. of Western Australia, Nedlands, WESTERN AUSTRALIA
V. C. Brink, Plant Science Division, Univ. of British Columbia, Vancouver 8, CANADA
L. Browder, Botany and Plant Path. Dept., Kansas State University, Manhattan, Kansas, 66504
A. R. Brown, Dept. of Agronomy, University of Georgia, Athens, Georgia 30601

C. M. Brown, Agronomy Department, University of Illinois, Urbana, Illinois
J. Artie Browning, Plant Path. Dept., Iowa State Univ., Ames, Iowa 50010
G. W. Bruehl, Plant Path. Dept., Washington State College, Pullman, Washington
V. D. Burrows, Canada Dept. Agric. Res. Station, Central Experimental Farm, Ottawa, Ontario, CANADA
Elkin Bustamente, Dept. Botany and Plant Path., Iowa State University, Ames, Iowa 50010
F. A. Buttress, School of Agriculture, Univ. of Cambridge, Cambridge, ENGLAND
W. P. Byrd, Dept. Agron. and Soils, Clemson College, Clemson, South Carolina 29631
R. M. Caldwell, Dept. Botany and Plant Path., Purdue University, LaFayette, Indiana 47907
D. Cameron, Scottish Plant Breeding Station, Penlandfield, Roslin, Midlothian, SCOTLAND
H. M. Camper, Agric. Experiment Station, Warsaw, Virginia
V. B. Cardwell, San Juan Basin Experiment Station, Hesperus, Colorado
H. L. Chada, Entomology Dept., Oklahoma State University, Stillwater, Oklahoma 74075
Te-Tzu Chang, Internation Rice Research Institute, Manila Hotel, Manila, PHILIPPINES
W. H. Chapman, North Florida Experiment Station, P.O. Box 470, Quincy, Florida
R. M. Chatters, Radioisotopes and Radiations Laboratory, Washington State Univ. Pullman, Washington 99163
C. P. Cheng, Dept. Plant Pathology and Physiology, Virginia Polytechnic Institute, Blacksburg, Virginia 24061
B. L. Chona, Div. of Mycology and Plant Path., Indiana Agric. Research Institute, New Delhi 12, INDIA
B. E. Clark, Div. of Seed Investigations, N.Y.S. Agric. Exper. Sta., Geneva, New York
G. H. Clark, Research Station, Harrow, Ontario, CANADA
R. V. Clark, Cereal Crops Division, Central Experimental Farm, Ottawa, Ontario, CANADA
B. C. Clifford, Agronomy Dept., Purdue University, LaFayette, Indiana 47907
F. A. Coffman, Cereal Crops and Diseases, Plant Industry Station, Beltsville, Maryland 20705
L. E. Compton, Dept. of Botany and Plant Path., Purdue Univ., LaFayette, Indiana 47907
T. J. Conlon, Dickinson Experiment Station, Box 111, Dickinson, North Dakota 58601
B. F. Coon, Entomology Dept., Pennsylvania State University, University Park, Pennsylvania 16802
R. U. Cotter, Cooperative Rust, University of Minnesota, St. Paul, Minnesota 55101
E. R. Cowett, Agronomy Dept., Univ. of New Hampshire, Durham, New Hampshire
J. C. Craddock, World Collection of Small Grains, USDA Plant Industry Station, Beltsville, Maryland 20705
J. P. Craigmiles, Texas Agric. Exper. Station, Rt. 5, Box 366, Beaumont, Texas 77706
W. F. Crosier, Dept. of Seed Investigations, NYS Agric. Experiment Station, Geneva, New York
L. V. Crowder, Plant Breeding Dept., Cornell University, Ithaca, New York 14850
D. G. Cummings, Georgia Experiment Station, Experiment, Georgia

R. G. Dahms, Ent. Res. Division, Grain and Forage Insects Research Branch, USDA Plant Industry Station, Beltsville, Maryland 20705
K. D. Dalal, Genetics Dept., Iowa State University, Ames, Iowa 50010
R. Davis, Southern Grain Insects Research Laboratory, Tifton, Georgia
Arden D. Day, Agronomy Dept., University of Arizona, Tucson, Arizona 85721
Maximo Alcala de Stefano, Inst. Nacional de Investigaciones Agricolas, Londres No. 40, Mexico 8, D.F.
Amos Dinoor, Faculty of Agriculture, The Hebrew University, P.O. B. 12, Rehovot, ISRAEL
Director, Research Station, P. O. Box 400, Ste-Anne-de-la-Pocatiere, Cte de Kamouraska, P.Q., CANADA
R. Dischinger, Productos Alimenticios Quaker S.A., Cx. Postal 2501, Porto Alegre, BRAZIL
G. E. Dixon, Plant Breeding Station, Njoro, Kenya, AFRICA
R. D. Durbin, Plant Path. Dept., Univ. of Wisconsin, Madison, Wisconsin
P. L. Dyck, Dept. Agriculture, Genetics and Plant Breeding, Research Institute, Ottawa, CANADA
H. L. Early, Agronomy Dept., University of Tennessee, Knoxville, Tennessee
D. C. Ebeltoft, Rm. 231 Walster Hall, North Dakota State University, Fargo, North Dakota
L. V. Edgington, Botany Dept., O.A.C., Guelph, Ontario, CANADA
A. H. Ellingboe, Crop Science Dept., Michigan State University, East Lansing, Michigan
W. A. Elliott, Dept. Field Crops, Univ. of Missouri, Columbia, Missouri 65201
B. E. Eisenburg, Dept. Genetics, Univ. of Stellenbasch, SOUTH AFRICA
E. B. Eskew, Dept. of Agronomy and Soils, Clemson College, Clemson, South Carolina 29631
H. N. Fafever, Agronomy Dept., Ohio Agricultural Research & Development Center, Wooster, Ohio 44691
D. G. Faris, Research Station, Box 29, Beaverlodge, Alberta, CANADA
V. C. Finkner, Agronomy Dept., Univ. of Kentucky, Lexington, Kentucky
P. J. Fitzgerald, Northern Grain Insect Research Laboratory, Brookings, South Dakota
G. Fleischmann, Dept. Agric. Res. Station, Box 6200, Univ. of Manitoba, Winnipeg 1, CANADA
W. H. Foote, Dept. of Farm Crops, Oregon State University, Corvallis, Oregon, 97331
R. A. Forsberg, Agronomy Dept., University of Wisconsin, Madison, Wisconsin
W. L. Fowler, Kansas Crop Improvement Assoc., Kansas State University, Manhattan, Kansas 66504
K. J. Frey, Dept. of Agronomy, Iowa State University, Ames, Iowa 50010
H. I. Friesen, Canadian Seed Growers Assoc., G.P.O. Box 455, Ottawa 2, Ontario, CANADA
M. C. Futrell, Dept. Plant Sciences, Texas A and M University, College Station, Texas 77840
J. H. Gardenhire, Rt. 1, Box 547, Texas Agricultural Experiment Substation 6, Denton, Texas
F. M. Gauthier, Laval University, Quebec, CANADA
U. R. Gore, Agronomy Department, Georgia Experiment Station, Experiment, Georgia
J. E. Grafius, Department of Crop Science, Michigan State University, East Lansing, Michigan
C. R. Graves, Agronomy Dept., Univ. of Tennessee, Knoxville, Tennessee
G. J. Green, Canada Agric. Research Sta., Box 6200, University of Manitoba, Winnipeg 1, Manitoba, CANADA
W. L. Griffeth, Agronomy Dept., Cornell University, Ithaca, New York 14850

D. J. Griffiths, Welsh Plant Breeding Station, Plas Gogerddan, Nr. Aberystwyth, Cardiganshire, WALES, U.K.
R. Grindeland, Agronomy Department, Iowa State University, Ames, Iowa 50010
P. M. Guerin, Hawkesbury Agricultural College, Richmond, N.S.W., AUSTRALIA
A. A. Guitard, Experimental Farm, Beaverlodge, Alberta, CANADA
E. J. Guthrie, International Rust Testing Centre, Plant Breeding Station, P.O. NJORO, KENYA
N. O. Hagberth, Oat Breeding Department, Weibullsholm, Landskrona, SWEDEN
P. M. Halisky, Plant Biology Department, Rutgers Univ., New Brunswick, New Jersey 08903
Sv. E. Hansen, Statens Forsogsstation, Tylstrup, DENMARK
E. D. Hansing, Department of Botany and Plant Path., Kansas State University, Manhattan, Kansas 66502
H. F. Harrison, Coker's Pedigreed Seed Co., Hartsville, South Carolina
T. E. Haus, Department of Agronomy, A. & M. College, Fort Collins, Colorado 80521
U. D. Havelka, Agricultural Experiment Station, Temple, Texas
E. B. Hayden, Rust Prevention Association, 820 Midland Bank Building, Minneapolis, Minnesota 55101
J. D. Hayes, Welsh Plant Breeding Station, Nr. Aberystwyth, Cardiganshire, Wales, U.K.
R. M. Hayes, Branch Experiment Station, Aberdeen, Idaho
Carl Hayward, Mount Vernon, Missouri
Charles Hayward, Field Crops Department, University of Missouri, Columbia, Missouri
A. Heagle, Plant Path. and Phys., University of Minnesota, St. Paul, Minnesota 55101
T. T. Hebert, Field Crops Department, North Carolina State College, Raleigh, North Carolina
B. Henriksen, Plant Science Department, University of Idaho, Moscow, Idaho
D. C. Hess, Agronomy Department, Univ. of Wisconsin, Madison, Wisconsin
E. G. Heyne, Agronomy Department, Waters Hall, Kansas State Univ., Manhattan, Kansas 66502
C. Hobbs, Dept. Plant Sciences, Texas A & M University, College Station, Texas 77840
C. S. Holton, 367 Johnson Hall, Washington State College, Pullman, Washington
Marilyn Holton, Crop Science Department, North Carolina State College, Raleigh, North Carolina
A. L. Hooker, Plant Path. Dept., University of Illinois, Urbana, Illinois
P. Hoskins, Field Crops Department, Univ. of Missouri, Columbia, Missouri 65201
Tzao Huang, Agronomy Department, Iowa State University, Ames, Iowa 50010
D. N. Huntley, Dept. of Field Husbandry, Ontario Agric. College, Guelph, Ontario, CANADA
J. C. Hussey, Jr., Productos Alimenticios Quaker S.A., Av. Senador Queiroz, 605, Sao Paulo, BRAZIL, S.A.
Ing. Agron. Sergio Rivas, Casilla 1196, Temuco, CHILE, S.A.
S. S. Ivanoff, Dept. Plant Path. and Physiology, Mississippi State University, State College, Mississippi
International Rice Research Institute, Manila Hotel, Manila, The PHILIPPINES
B. R. Jackson, Agronomy Dept., Oklahoma State Univ., Stillwater, Oklahoma 74075
Edwin James, National Seed Storage Laboratory, Fort Collins, Colorado 80521
H. Jedlinski, 248 Davenport Hall, University of Illinois, Urbana, Illinois
M. D. Jellum, Georgia Experiment Station, Experiment, Georgia

G. Jenkins, Plant Breeding Institute, Trumpington, Cambridge, ENGLAND
N. F. Jensen, Department of Plant Breeding, Cornell University, Ithaca, New York, 14850
S. G. Jensen, Northern Grain Insect Research Laboratory, Brookings, South Dakota
T. Johnson, Dominion Lab. of Plant Path., Winnipeg, Manitoba, CANADA
V. A. Johnson, Agronomy Department, University of Nebraska, Lincoln, Nebraska 68503
C. O. Johnston, Dept. of Botany and Plant Path., Kansas State University, Manhattan, Kansas 66504
T. H. Johnston, Rice Branch Experiment Station, P.O. Box 287, Stuttgart, Arkansas 72160
R. P. Johnston, P.O. Box 231, Warwick, Queensland, AUSTRALIA
R. L. Johnstone, Productos Quaker S.A., Apartado Aereo 2074, Cali Valle, COLOMBIA, S.A.
Buford Jones, Supervisor, State Seed Lab., 122 Capitol Bldg., Oklahoma City, Oklahoma 73105
J. P. Jones, Plant Path. Dept., University of Arkansas, Fayetteville, Arkansas
S. N. Joshi, Agronomy Department, Iowa State University, Ames, Iowa 50010
J. R. Justin, Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota 55101
M. L. Kaufmann, Cereals Crops Research, Lacombe, Alberta, CANADA
J. A. Keaton, Coker's Pedigreed Co., Hartsville, South Carolina
W. K. Kennedy, Assoc. Dean of Agriculture, Cornell University, Ithaca, New York 14850
G. C. Kent, Dept. of Plant Path., Cornell University, Ithaca, New York 14850
M. F. Kernkamp, Cooperative Rust Laboratory, Univ. of Minnesota, St. Paul, Minnesota 55101
J. Khair, Dept. Plant Pathology, Faculty of Agriculture, P.O. Box 12, Rehovot, ISRAEL
R. L. Kiesling, Plant Path. Dept., North Dakota State University, Fargo, North Dakota 58103
R. A. Kilpatrick, Soil and Crop Sciences, Texas A & M University, College Station, Texas
G. C. Kingsland, Botany and Bacteriology Department, Clemson University, Clemson, South Carolina 29631
E. Kivi, Plant Breeding Station, Tammisto, Helsingin pitaja, FINLAND
R. A. Kleese, Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minnesota 55101
H. R. Klinck, Agronomy Department, MacDonald College, Quebec, CANADA
D. M. Kline, Agronomy Department, University of North Carolina, Raleigh, North Carolina
Carl Koehler, W. O. McCurdy and Sons, Fremont, Iowa
C. F. Konzak, International Atomic Energy Agency, Kaerntnerring 11, Vienna 1, AUSTRIA
B. Kostic, Plant Breeding Institute, Kragujevac, YUGOSLAVIA
R. Krenzen, Agronomy Department, Cornell University, Ithaca, New York 14850
C. F. Krull, Rockefeller Foundation, Apartado Aereo 5813, Bogota, COLOMBIA, S.A.
T. Kumagai, Crop Science Lab., Hokkaido Natl. Agr. Experiment Station, Hitzujigaoka, Sapporo, JAPAN
A. G. Kusch, Experimental Farm, Scott, Saskatchewan, CANADA
K. A. Lahr, Agricultural Experiment Station, Chillicothe, Texas
C. A. Lamb, Agronomy Department, Ohio Agricultural Experiment Station, Wooster Ohio

Rune Larsson, Plant Husbandry Department, Agricultural College of Sweden, Uppsala 7, SWEDEN

C. Lehmann, Deutsche Akademie Der Wissenschaften Zu Berlin, Institut Fur Kilturpflanzenforschung, Gatersleben, GERMANY

W. H. Leonard, Department of Agronomy, Colorado State University, Fort Collins, Colorado 80521

Library of Congress, Exchange and Gift Division, Washington, D.C. 20540

R. Livers, Fort Hays Branch Station, Hays, Kansas 67601

J. Lofgren, Agronomy Department, Kansas State Univ., Manhattan, Kansas 66502

C. C. Lowe, Plant Breeding Department, Cornell University, Ithaca, New York 14850

O. W. Luetkemeier, Agronomy Department, Purdue University, Lafayette, Indiana 47907

H. H. Luke, Dept. Plant Path., University of Florida, Gainesville, Florida

S. Lund, Agronomy Department, Rutgers University, New Brunswick, New Jersey

E. S. Luttrell, Agronomy Dept., Georgia Agricultural Experiment Station, Experiment, Georgia

James MacKey, Department Genetics and Plant Breeding, Agricultural College of Sweden, Uppsala 7, SWEDEN

H. G. Marshall, Agronomy Department, Penn State Univ., University Park, Pennsylvania 16802

W. H. Marshall, Minnesota Crop Improvement Association, University of Minnesota, St. Paul, Minnesota 55101

G. D. Massey, Agronomy Department, University of Arizona, Tucson, Arizona

R. C. McGinnis, Dept. Plant Science, University of Manitoba, Winnipeg, Manitoba, CANADA

R. I. H. McKenzie, Dept. Agricultural Research Station, 25 Dafoe Road, Univ. of Manitoba, Winnipeg 19, Manitoba, CANADA

K. P. Maniphong, Genetics Department, Iowa State University, Ames, Iowa 50010

J. W. Martens, Canada Department of Agriculture, Research Branch, 25 Dafoe Road, Winnipeg 19, Manitoba, CANADA

M. McDaniel, Soil and Crop Sciences, Texas A & M University, Stillwater, Oklahoma 74075

J. L. McMullan, Dept. Agriculture, Jarrah Road, South Perth, West Australia

M. J. McNeil, Agronomy Department, Iowa State Univ., Ames, Iowa 50010

F. W. McLaughlin, North Carolina Crop Improvement Association, State College Station, Raleigh, North Carolina 27607

D. V. McVey, USDA, Federal Experiment Station, Mayaguez, PUERTO RICO

J. P. Meiners, Oat Investigations, USDA Plant Industry Station, Beltsville, Maryland 20705

L. Michael, Botany Department, Iowa State University, Ames, Iowa 50010

G. K. Middleton, McNair Seed Co., Laurinburg, North Carolina

Dr. K. Mikkelsen, Norges Lantbrukshogskoles Akervekstforsok, Vollebekk, NORWAY

J. D. Miller, Federal Experiment Station, Mayaguez, PUERTO RICO

J. J. Mock, Agronomy Department, Iowa State University, Ames, Iowa 50010

C. L. Moore, Agronomy Department, Oklahoma State University, Stillwater, Oklahoma 74075

M. B. Moore, Department of Plant Path., University of Minnesota, St. Paul, Minnesota 55101

I. N. Morales, Ofician de Estudios Especiales, Loudres 40, Mexico 6, D.F. MEXICO

D. D. Morey, Coastal Plain Experiment Station, Tifton, Georgia 31794

Dr. K. Multamaki, Department of Plant Breeding, Jokioinen, FINLAND

R. L. Munjal, Division Mycology and Plant Path., Indian Agricultural Research Institute, New Delhi 12, INDIA
Aage Munk, Landbrugets Kornforaedling, Sejet, Horsens, DENMARK
C. F. Murphy, Crop Science Department, North Carolina State University, Raleigh North Carolina
H. C. Murphy, Oat Investigations, USDA Plant Industry Station, Beltsville, Maryland 20705
R. B. Musgrave, Agronomy Department, Cornell University, Ithaca, New York 14850
J. W. Neely, Coker's Pedigreed Seed Co., Hartsville, South Carolina
J. P. Newton, Forage Crop Section, Georgia Experiment Station, Experiment, Georgia
M. F. Newton, Crop Science Department, North Carolina State College, Raleigh, North Carolina
Nielson, Productos Alimenticios Quaker S.A., Caixa Postal, 2501 Porto Alegre, R. G. S., BRAZIL, S. A.
Ichizo Nishiyama, Faculty of Agriculture, Kyoto University, Kyoto, JAPAN
L. W. Nittler, Department of Seed Investigations, NYS Agric. Exper. Station, Geneva, New York
M. J. Norris, Agricultural Experiment Station, McGregor, Texas
Gosta Olsson, Swedish Seed Association, Svalof, SWEDEN
J. G. O'Mara, Genetics Department, Iowa State University, Ames, Iowa 50010
Thomas O'Sullivan, Cereal Station, Ballinacurra, Co. Cork, IRELAND
R. M. Oswalt, Department of Agronomy, Oklahoma State Univ., Stillwater, Oklahoma 74075
H. Otto, Agricultural Extension Service, Univ. of Minnesota, St. Paul, Minnesota 55101
Luis Padre, Dept. Botany and Plant Pathology, Iowa State University, Ames, Iowa 50010
W. D. Pardee, Plant Breeding Department, Cornell University, Ithaca, New York 14850
F. L. Patterson, Agronomy Department, Purdue University, LaFayette, Indiana 47907
P. E. Pawlisch, Department Soil and Crops Sciences, Texas A. and M. College, College Station, Texas
V. D. Pederson, Dept. Plant Path., South Dakota State University, Brookings, South Dakota 57007
J. W. Pendleton, Agronomy Department, University of Illinois, Urbana, Illinois
Per-Johan Persson, Sveriges Utsadesforenings Vastgotafilial, Skara, SWEDEN
J. T. Pesek, Agronomy Department, Iowa State University, Ames, Iowa 50010
J. L. Peterson, Plant Pathology, Rutgers University, New Brunswick, New Jersey
F. C. Petr, Branch Experiment Station, Aberdeen, Idaho
B. Peturson, Plant Path. Lab., Box 322, University of Manitoba, Winnipeg, Manitoba, CANADA
R. Pfeifer, Agronomy Department, Pennsylvania State University, University Park, Pennsylvania.
E. C. Pifer, USDA, Agronomy Dept., Penn State Univ., University Park, Pennsylvania 16802
J. M. Poehlman, Dept. of Field Crops, Univ. of Missouri, Columbia, Missouri 65201
Aleksa Popovic, Plant Breeding Institute, Kragujevac, YUGOSLAVIA
F. M. Porter, Oat Section, USDA Plant Industry Station, Beltsville, Maryland 20705
K. B. Porter, U.S. Great Plains Field Station, Bushland, Texas 79012
G. L. Posler, Dept. Field Crops, Univ. of Missouri, Columbia, Missouri 65201

Mrs. Marie Prechtl, USDA Oat Section, Plant Industry Station, Beltsville, Maryland 20705
J. Purcell, Dept. of Agriculture, Cereal Breeding Sta., Backweston, Leixlip, Co. Kildare, IRELAND
C. O. Qualset, Agronomy Dept., Univ. of Tennessee, Knoxville, Tennessee
T. Rajhathy, Ottawa Research Station, Central Experimental Farm, Ottawa CANADA
D. A. Ray, Dept. Agronomy, Ohio State University, Columbus, Ohio 43210
E. Reinbergs, Crops Science Dept., O.A.C., Guelph, Ontario, CANADA
W. Reiss, Agronomy Department, Purdue University, LaFayette, Indiana 47907
Matti Rekunen, Plant Breeding Institute of Hankkija, Tammisto, Helsingen pit, FINLAND
L. Reyes, Agricultural Experiment Station, Beeville, Texas
R. Reyes, c/o Rockefeller Foundation, Apartado Aereo 5813, Bogota, D.E., COLOMBIA, S. A.
C. W. Roane, Dept. Plant Path. and Physiology, Virginia Polytechnic Institute, Blacksburg, Virginia 24061
B. J. Roberts, Dept. of Plant Path., Univ. of Minnesota, St. Paul, Minnesota 55101
J. J. Roberts, Agronomy Department, Purdue University, LaFayette, Indiana 47907
W. F. Rochow, Dept. of Plant Path., Cornell Univ., Ithaca, New York 14850
H. A. Rodenhiser, Crops Research Div., Plant Industry Station, Beltsville, Maryland 20705
C. R. Rohde, Pendleton Branch Experiment Sta., P.O. Box 370, Pendleton, Oregon 97801
Magnus Roland, Weibullsholms Plant Breeding Inst., Bjertorp, Stora Hov., SWEDEN
R. W. Romig, Cooperative Rust Laboratory, Univ. of Minnesota, St. Paul, Minnesota 55101
W. M. Ross, Fort Hays Experiment Station, Hays, Kansas 67601
R. G. Rothgeb, Agronomy Dept., Univ. of Maryland, College Park, Maryland
P. C. Rothman, Delta Experiment Station, Stoneville, Mississippi
J. N. Rutger, Plant Breeding Department, Cornell University, Ithaca, New York 14850
E. E. Saari, Agronomy Department, Oklahoma State Univ., Stillwater, Oklahoma 74705
K. S. Sadanaga, Dept. of Genetics, Iowa State Univ., Ames, Iowa 50010
J. F. Schafer, Botany and Plant Path. Dept., Purdue University, LaFayette, Indiana 47907
A. M. Schlehuber, Agronomy Department, Oklahoma State University, Stillwater, Oklahoma 74075
J. W. Schmidt, Dept. of Agronomy, University of Nebraska, Lincoln, Nebraska 68503
O. E. Schultz, Plant Path. Dept., Cornell University, Ithaca, New York 14850
W. O. Scott, Agronomy Department, Univ. of Illinois, Urbana, Illinois
Dale Sechler, North Florida Experiment Sta., P.O. Box 470, Quincy, Florida
Secretary, National Oat Conference
H. L. Shands, Dept. of Agronomy, Univ. of Wisconsin, Madison 6, Wisconsin
Henry Shands, Agronomy Department, Purdue University, Lafayette, Indiana 47907
J. F. Shane, Agronomy Department, University of Kentucky, Lexington, Kentucky
L. H. Shebeski, Dept. of Plant Science, Univ. of Manitoba, Winnipeg, Manitoba, CANADA
R. M. Shibles, Agronomy Department, Iowa State University, Ames, Iowa 50010

M. C. Shurtleff, 241 Davenport Hall, Univ. of Illinois, Urbana, Illinois
B. Sigurbjornsson, c/o International Atomic Energy Agency, Vienna 1, Kaerntnerring, AUSTRIA
M. D. Simons, Botany Hall, Iowa State Univ., Ames, Iowa 50010
A. V. Skepasts, Field Husbandry, Kemptville Agric. School, Kemptville, Ontario, CANADA
L. Slootmaker, Stichting voor Plantenveredeling, Lawickse Allee 166, Wageningen, NETHERLANDS
Joval Smiljakovic, Plant Breeding Institute, Kragujevac, YUGOSLAVIA
F. G. Smith, Dept. Botany and Plant Path., Iowa State Univ., Ames, Iowa 50010
G. S. Smith, Agronomy Dept., North Dakota Agric. College, State College Station, Fargo, North Dakota
H. C. Smith, Plant Diseases Division, D.S.I.R., P.B. Christchurch, NEW ZEALAND
H. H. Smith, Biology Dept., Brookhaven National Laboratories, Upton, L.I., New York
O. D. Smith, Dept. Agronomy and Plant Genetics, Univ. of Minnesota, St. Paul, Minnesota 55101
R. L. Smith, Agronomy Dept., Iowa State Univ., Ames, Iowa 50010
G. E. Spain, Agronomy Extension, Univ. of North Carolina, Raleigh, North Carolina
J. J. Stanton, Jr., Coker's Pedigreed Seed Co., Hartsville, S. Carolina
T. M. Starling, Agronomy Department, Virginia Polytechnic Institute, Blacksburg, Virginia 24061
J. D. E. Sterling, Experimental Farm, P.O. Box 1210, Charlottetown, P.E.I., CANADA
Harland Stevens, Branch Experiment Station, Aberdeen, Idaho
D. M. Stewart, Cooperative Rust Laboratory, Univ. of Minn., St. Paul, Minnesota 55101
W. G. Stewart, Extension Agronomist, Colorado State Univ., Fort Collings, Colorado 80521
J. W. Stiles, Director of Research, Agway, Inc., Syracuse, New York
R. K. Stivers, Agronomy Department, Purdue Univ., Lafayette, Indiana 47907
Dr. Strand, College of Agriculture, As, NORWAY
D. D. Stuthman, Agronomy Department, Purdue University, Lafayette, Indiana 47907
C. A. Suneson, Agronomy Department, University of California, Davis, California
M. L. Swearingen, Agronomy Dept., Purdue Univ., Lafayette, Indiana 47907
A. Sztejnberg, Department of Plant Path., Faculty of Agriculture, P.O. Box 12, Rehovot, ISRAEL
Seiji Tabata, Crop Science Lab., Hitsujigaoka, Sapporo, JAPAN
L. A. Tatum, Chief, Beltsville, Maryland 20705
G. A. Taylor, Agronomy Department, Iowa State University, Ames, Iowa 50010
L. H. Taylor, Dept. of Agronomy, Virginia Polytech. Inst., Blacksburg, Virginia 24061
R. K. Thompson, Agronomy Dept., Univ. of Arizona, Tucson, Arizona
H. C. Thorpe, U. N. Tech. Assistance Bd., P.O. Box 1555, Teheran, IRAN
R. L. Thurman, Dept. of Agronomy, Univ. of Arkansas, Fayetteville, Arkansas
D. Tiyawalee, Agronomy Dept., Iowa State University, Ames, Iowa 50010
R. W. Toler, Georgia Coastal Plain Exper. Station, Tifton, Georgia
W. E. Tossell, Crop Science Dept., Ontario Agric. College, Guelph, Ontario, CANADA
J. L. Tramel, Agronomy Dept., VPI, Blacksburg, Virginia, 24061
T. C. Tucker, Agronomy Dept., University of Arizona, Tucson, Arizona

L. J. Tyler, Dept. of Plant Path., Cornell Univ., Ithaca, New York 14850
U. S. Department Agriculture Library, Current Serial Record, Washington, D.C.
Max Urich, Kansas Crop Improvement Assoc., Kansas State University, Manhattan, Kansas 66504
R. S. Vasudeva, Div. Mycology and Plant Path., Indian Agric. Res. Institute, New Delhi, INDIA
M. G. Vavich, Agronomy Dept., Univ. of Arizona, Tucson, Arizona
Mario Vela-Cardenas, I.N.I.A., Londres No. 40, MEXICO 6, D.F.
H. A. B. Vestergaard, Abed, Sollested, DENMARK
I. Wahl, Facultry of Agriculture, The Hebrew University, P.O.B. 12, Rehovot, ISRAEL
A. T. Wallace, Plant Science Section, Univ. of Florida, Gainesville, Florida
D. D. Warnes, Agronomy Department, Univ. of Nebraska, Lincoln, Nebraska 68503
I. A. Watson, Dept. of Agriculture, University of Sydney, Sydney, AUSTRALIA
D. E. Weibel, Agronomy Dept., Oklahoma State Univ., Stillwater, Oklahoma 74075
H. L. Weir, Box 1069, Little Rock, Arkansas
D. E. Western, The Quaker Oats Company, Chicago, Illinois 60654
P. Wetter, Northrup, King and Co., 1500 Jackson Str., NE, Minneapolis, Minnesota 55413
D. A. Whitney, Agronomy Dept., Iowa State Univ., Ames, Iowa 50010
Arne Wieberg, Swedish Seed Association, Svalof, SWEDEN
Kjell Wiklund, Lannas, Undrom, SWEDEN
J. C. Williams, Agronomy Dept., Univ. of California, Davis, California
L. S. Wood, Plant Path. Dept., South Dakota State College, Brookings, South Dakota
R. W. Woodward, Agronomy Dept., Utah State University, Logan, Utah
G. M. Wright, Dept. Scientific and Industrial Research, Crop Research Div., Christchurch, NEW ZEALAND
T. D. Wyllie, Field Crops Department, University of Missouri, Columbia, Missouri
W. S. Young, Crop Science Dept., O.A.C., Guelph, Ontario, CANADA
F. J. Zillinsky, Genetics and Plant Breeding Research Institute, Central Experimental Farm, Ottawa, Ontario, CANADA

##################